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RESCINDED

TECHNICAL MANUAL

LIST OF APPLICABLE PUBLICATIONS

MISSILE AND EQUIPMENT

SM-75 WEAPON SYSTEM

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RESCINDED

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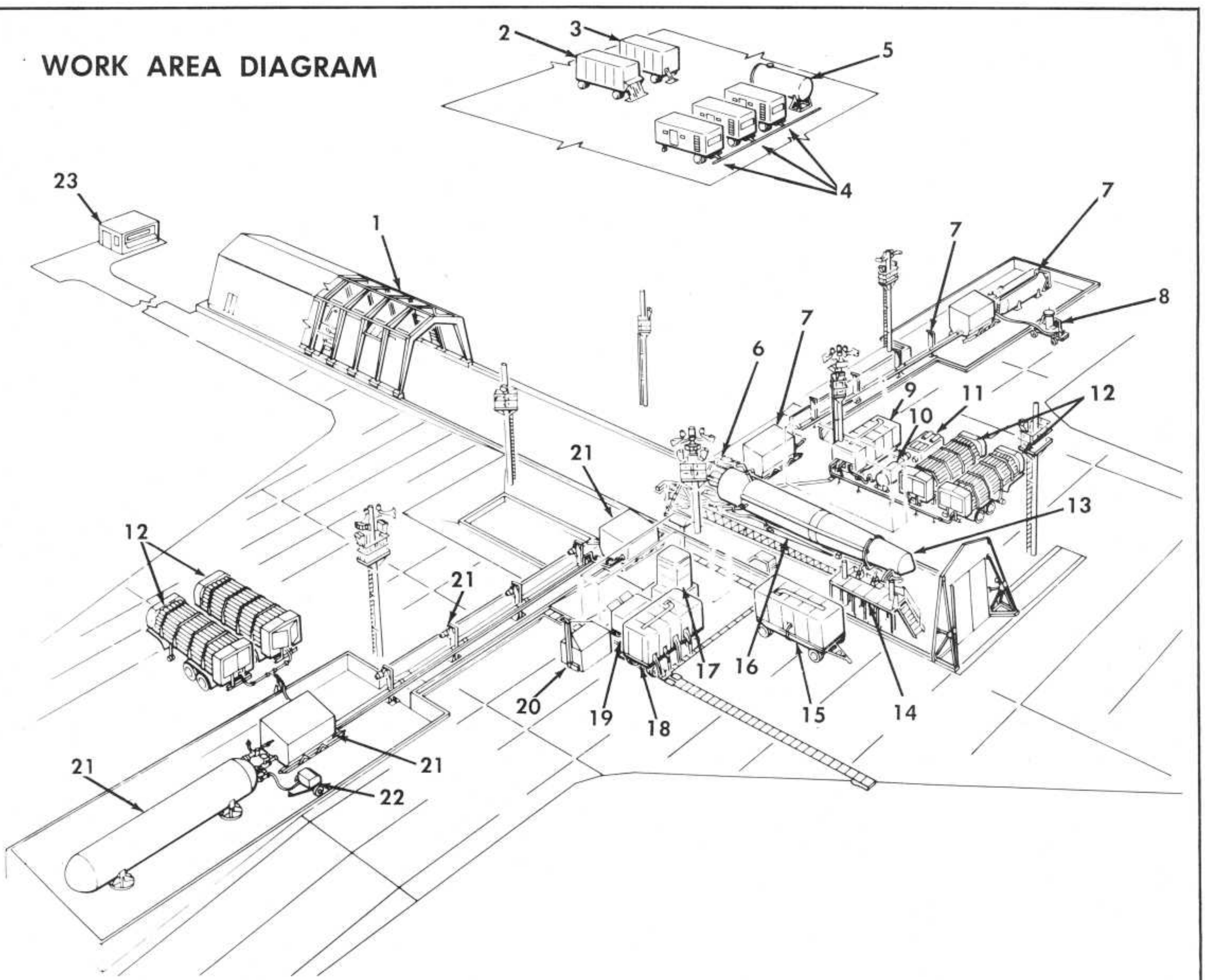
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28 SEPTEMBER 1962

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15. TRAILER-MOUNTED BALLISTIC MISSILE SYSTEM CHECKOUT STATION TTU-92/M*
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*THIS EQUIPMENT LOCATED AT THE LAUNCH EMPLACEMENT AND RIM BUILDING

†INSPECTION REQUIREMENTS ON THIS EQUIPMENT DO NOT APPEAR IN THE INSPECTION REQUIREMENTS MANUAL

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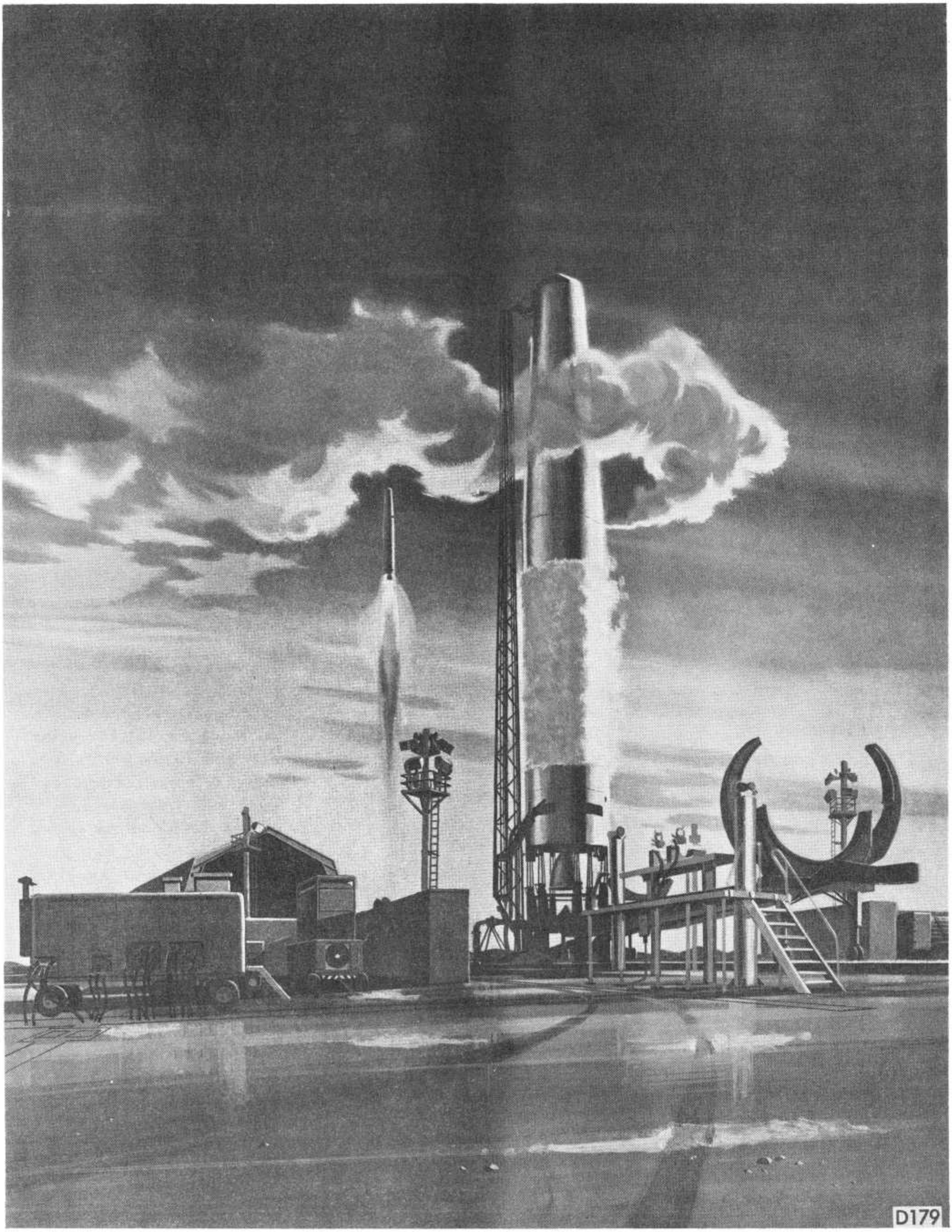


Figure i-1. SM-75 Missile

SECTION I

GENERAL DESCRIPTION

1-1. PURPOSE OF THE MANUAL.

1-2. This manual describes the scope of the SM-75 Weapon System. Instructions are not included and theory is confined to the needs of personnel requiring general, rather than specific, knowledge of the weapon system.

1-3. DESCRIPTION OF THE WEAPON SYSTEM.

1-4. The weapon system consists of SM-75 missiles, their associated ground support equipment (GSE), installation facilities, and data support.

1-5. The weapon system is maintained and operated by squadrons. Each squadron is assigned 15 missiles which are operated from five launch positions. A launch position contains three launch emplacements and one launch control area. One missile is maintained and launched from each emplacement.

1-6. SM-75 MISSILE.

1-7. The weapon (figure 1-1) is a single-stage, vertically launched, intermediate range ballistic missile. It is 63 feet long and 8 feet in diameter through the constant portion of its cylindrical sections. The gross weight of the missile is approximately 109,800 pounds, of which 98,000 pounds are propellants. The forward section of the missile is tapered for engagement with a separable re-entry vehicle, containing a warhead. The missile is capable of projecting this warhead 300 to 1500 nautical miles.

1-8. The airframe consists of five sections and two exterior tunnels. The forward section on the guidance section, contains the flight controller, guidance system, and provisions for attaching the re-entry vehicle. Next is the fuel section which consists of a 4812-gallon fuel tank. The following section is the center body section which structurally joins the liquid oxygen tank and fuel tank sections. This section contains the rate gyros, rate distribution boxes, and provisions for mounting two retrorockets. The liquid oxygen section is a 7420-gallon tank for liquid oxygen. The after section is the engine and accessories section and contains the main engine, hydraulic accessory unit, and hydraulic pump, this section also mounts the two vernier engines. The tunnels protect plumbing and electrical accessories located outboard of the missile sections.

1-9. GROUND SUPPORT EQUIPMENT.

1-10. The term ground support equipment (GSE) refers to the nonairborne constituents of the weapon system.

1-11. LOCATION. GSE for the missiles is located in three areas: the launch position; the receiving, inspection, and maintenance (RIM) building; and the surveillance and inspection (SI) building.

1-12. Mobile GSE at the launch control area consists of electric power generation and distribution equipment and trailer-mounted equipment for monitoring and launching three missiles. Each of the launch emplacements has missile erecting-launching facilities, propellant transfer equipment, air-conditioning equipment, electrical and electronic missile standby and launching equipment, and communications equipment.

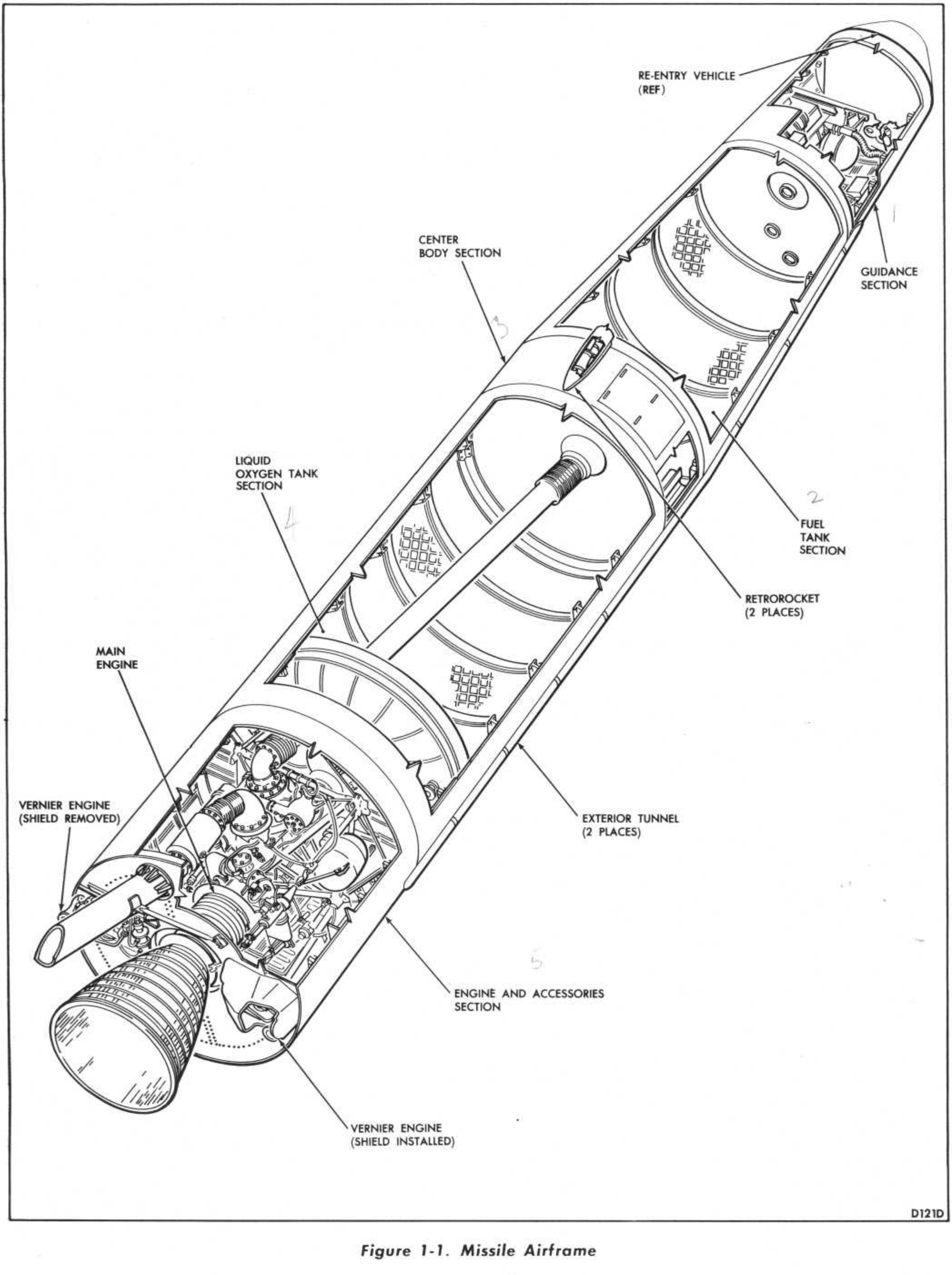


Figure 1-1. Missile Airframe

1-13. GSE at the RIM building is equipment required to receive, inspect, and perform maintenance and checkout operations on the missile and its components. Some of the maintenance and checkout equipment in the RIM building is mobile, and can be dispatched to the launch positions.

1-14. GSE at the SI building comprises the equipment to receive and inspect the re-entry vehicle, to prepare it for operational use and to prepare it for mating with the missile.

1-15. INSTALLATION FACILITIES.

1-16. Physical installations are required to shelter, support, and maintain the missile and its ground support equipment. Included in this categegory are the panelized prefabricated building, the base electric utility power, the liquid oxygen generating plant, the RIM building, the SI building, the munitions storage building, the airstrip, shops for the maintenance of the GSE, and the communications network.

1-17. RECEIVING, INSPECTION, AND MAINTENANCE BUILDING (TYPICAL). The RIM building (figure 1-2) is usually located near an airstrip. A typical RIM building contains a large central missile maintenance bay, specialized bench repair shops, and administrative and personnel facilities. Most of the administrative offices, a classroom, and the squadron control room are located in the mezzanine above one wing. The missile maintenance area accommodates a maximum of three missiles and the ground support equipment required to inspect and maintain these missiles. The bench repair shops are located in wings on both sides of the missile maintenance area.

1-18. PANELIZED BUILDING. The panelized building (figure 1-3) provides cover for the missile, immediate ground support equipment, and personnel, while the missile is in standby condition. Prior to missile erection, the building is moved to a position clear of the missile. As the building clears the missile it trips a switch automatically initiating erection of the missile. The building then continues to move to its fully retracted position at the uprange limit of its trackway. The drive mechanism for retracting the building is electrically powered and retraction switching occurs as an automatic function of the launching countdown. However, manual switching is necessary to return the building to standby location. The building is manufactured in the form of prefabricated assemblies. The panels of honeycomb-core sandwich construction are packaged in sizes and weights that can be easily transported to the squadron area in C-124 or C-133 aircraft.

1-19. LIQUID OXYGEN GENERATING PLANT. The liquid oxygen generating plant supplies the squadron with liquid oxygen, liquid nitrogen, and gaseous nitrogen. Special storage tanks and trailers are used to transport and store the nitrogen and oxygen at the launch emplacement and at the RIM building.

1-20. COMMUNICATIONS SYSTEM. The communications system provides telephone communication and public address facilities throughout the squadron. The system is divided into four basic networks: command, logistics, alert sound, and maintenance.

1-21. SQUADRON ORGANIZATION.

1-22. PERSONNEL ORGANIZATION (TYPICAL).

1-23. In addition to unit administration and unit supply, the squadron is responsible for operations, maintenance, and maintenance supply, (figure 1-4).

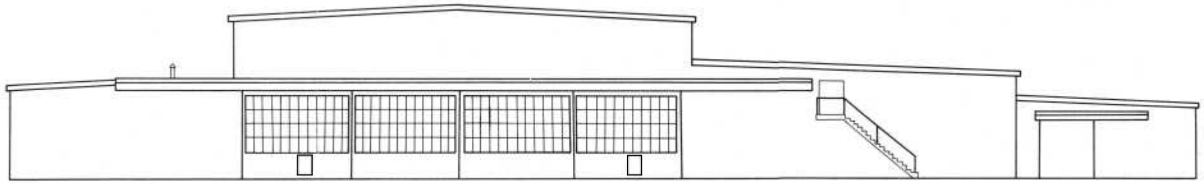
1-24. OPERATIONS. (See figure 1-5.) The chief of operations is responsible for all activities directly concerned with missile launching. He has jurisdiction over intelligence, training, squadron safety, security, communications-electronics, squadron control room personnel, and launch crews.

1-25. Squadron Control Room. The squadron control room is manned on a 24-hour basis to expedite operations orders from command headquarters. The operations duty officer gives the execution command to the launch control officers stationed in the launching control groups. He also establishes launch priority among the launch positions. The launch control officers in turn initiate the launchings of their respective missiles.

1-26. Launch Crews. Each launch crew is commanded by a launch control officer who is directly responsible to the operations duty officer for the manning of one launch position during one shift. The launch control officers stationed at the launch control areas are responsible for the surveillance of missiles in a ready condition and performing launch countdowns. Each launch control officer maintains direct communication with the officer in charge of the squadron control room. This keeps him informed at all times of the alert status, priority of launch, targeting, and rate of fire of his assigned missiles. Launch crews in addition to launching duties perform minor preventive maintenance such as cleaning, servicing, and daily inspections.

1-27. Training Section. This section is directed by the training officer. He is responsible for the coordination and scheduling of launch crew training. He also pro-

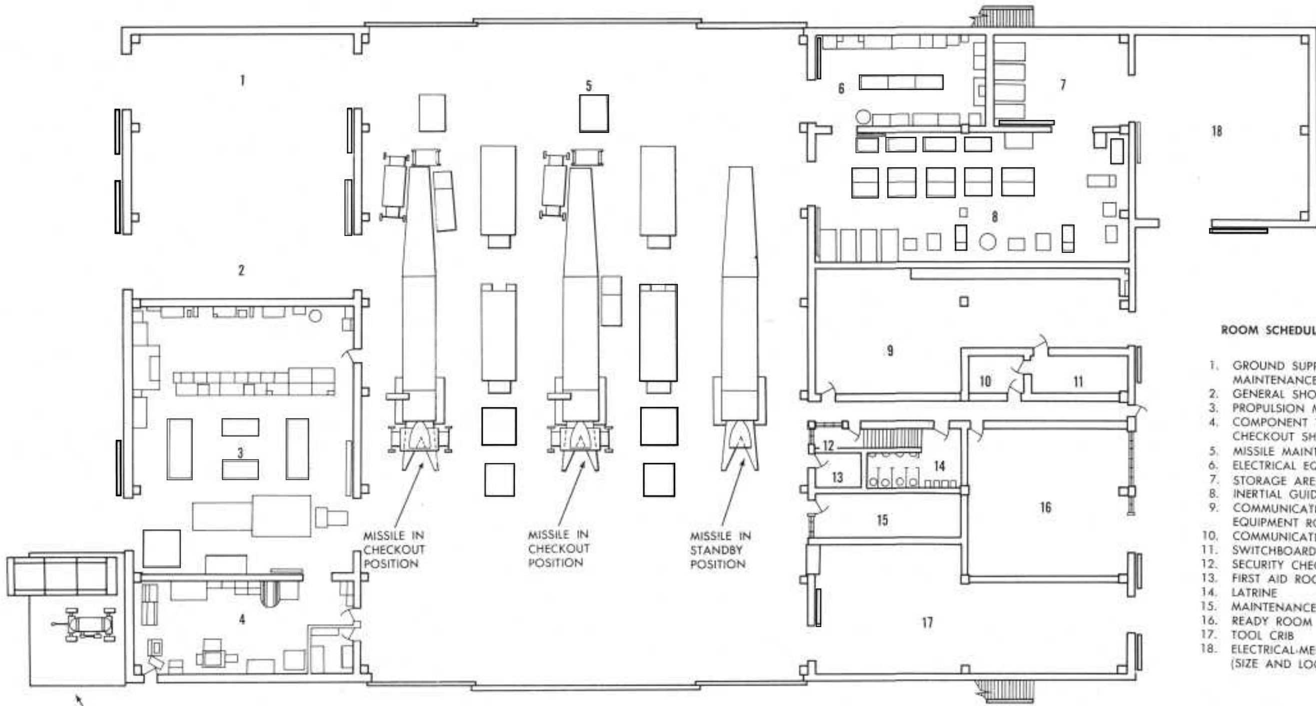
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PROFILE

ROOM SCHEDULE – MEZZANINE

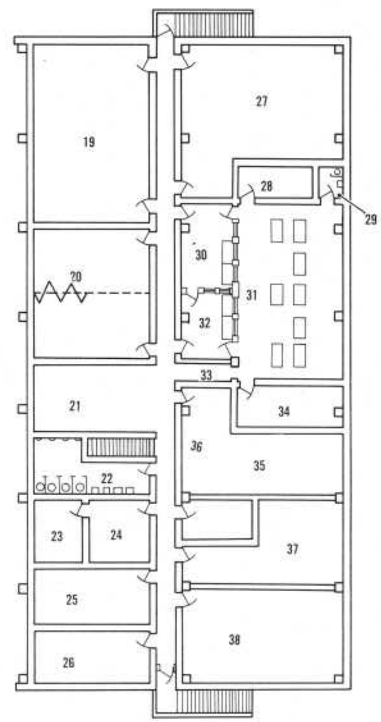
19. OPERATIONS TRAINING ROOM
20. CLASSROOM
21. SECURITY OFFICE
22. LATRINE
23. SQUADRON COMMANDER (PRIVATE OFFICE)
24. SQUADRON COMMANDER (OUTER OFFICE)
25. SAFETY OFFICER'S OFFICE
26. TECHNICAL REPRESENTATIVES' OFFICE
27. OPERATIONS ADMINISTRATION AND INTELLIGENCE OFFICE
28. TARGET MATERIAL STORAGE
29. LATRINE
30. SQUADRON OFFICER'S OFFICE
31. CONTROL ROOM
32. MAINTENANCE CONTROL OFFICER'S OFFICE
33. VESTIBULE
34. CONTROL ROOM COMMUNICATION CENTER
35. JOB CONTROL OFFICE
36. CHIEF OF MAINTENANCE'S OFFICE
37. MISSILE RECORDS AND ANALYSIS ROOM
38. QUALITY CONTROL OFFICE



GROUND FLOOR PLAN

ROOM SCHEDULE – GROUND FLOOR

1. GROUND SUPPORT EQUIPMENT MAINTENANCE SHOP
2. GENERAL SHOP
3. PROPULSION MAINTENANCE SHOP
4. COMPONENT TEST AND CHECKOUT SHOP
5. MISSILE MAINTENANCE BAY
6. ELECTRICAL EQUIPMENT SHOP
7. STORAGE AREA
8. INERTIAL GUIDANCE SHOP
9. COMMUNICATIONS TERMINAL AND EQUIPMENT ROOM
10. COMMUNICATIONS OFFICE
11. SWITCHBOARD ROOM
12. SECURITY CHECKPOINT
13. FIRST AID ROOM
14. LATRINE
15. MAINTENANCE SUPERVISOR'S OFFICE
16. READY ROOM
17. TOOL CRIB
18. ELECTRICAL-MECHANICAL ROOM (SIZE AND LOCATION AS REQ'D)



MEZZANINE PLAN

Figure 1-2. RIM Building (Typical)

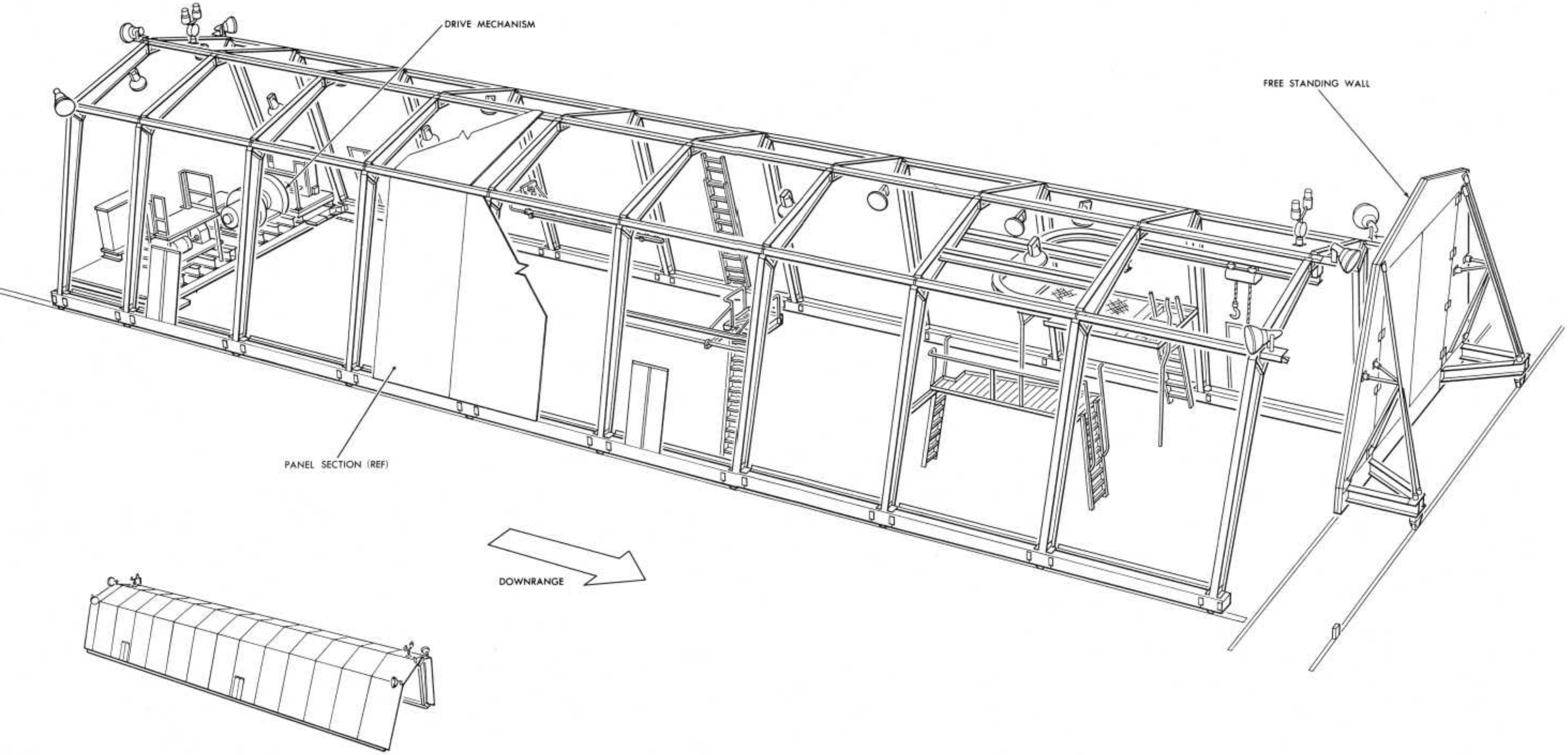


Figure 1-3. Panelized Building

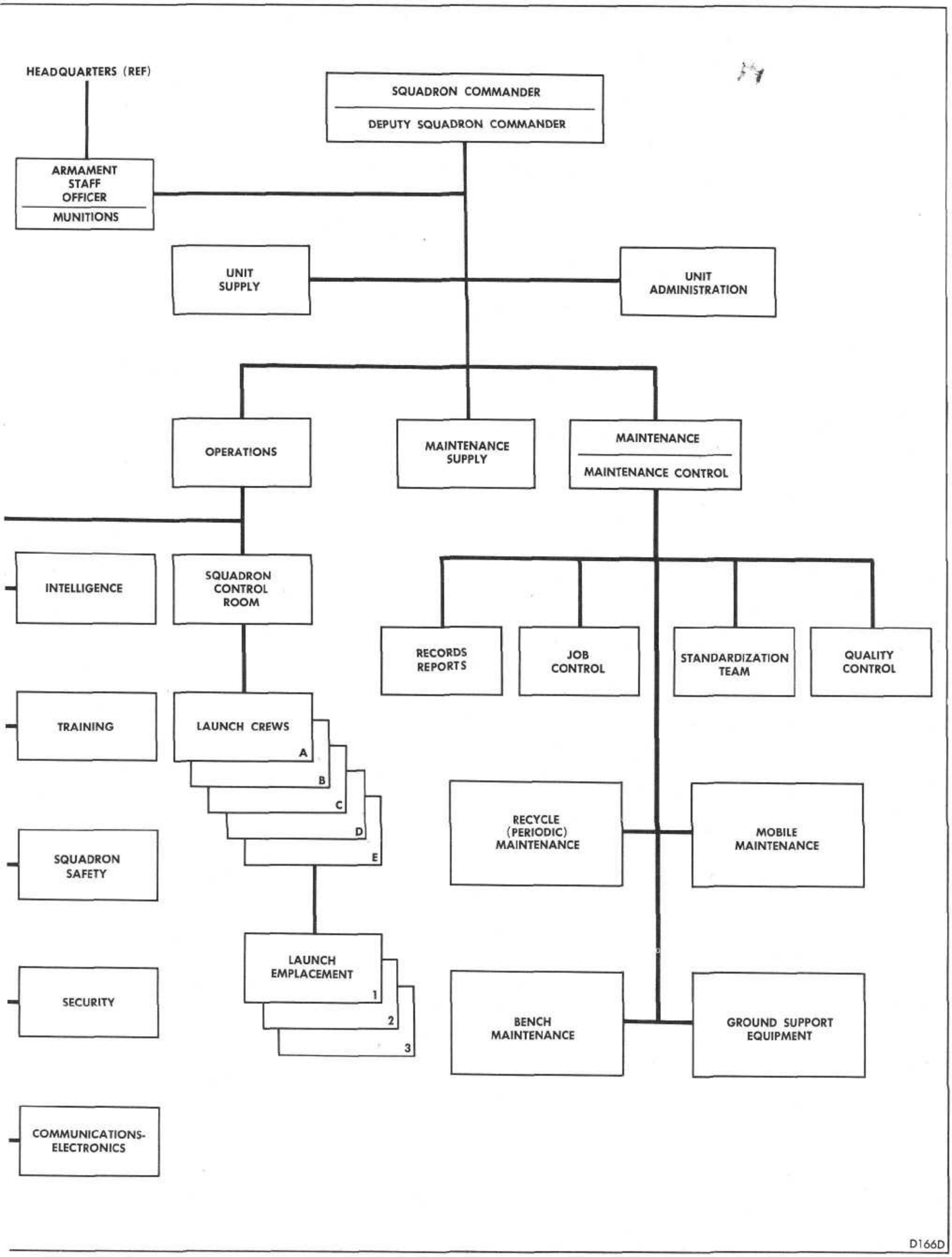


Figure 1-4. Squadron Organization Chart

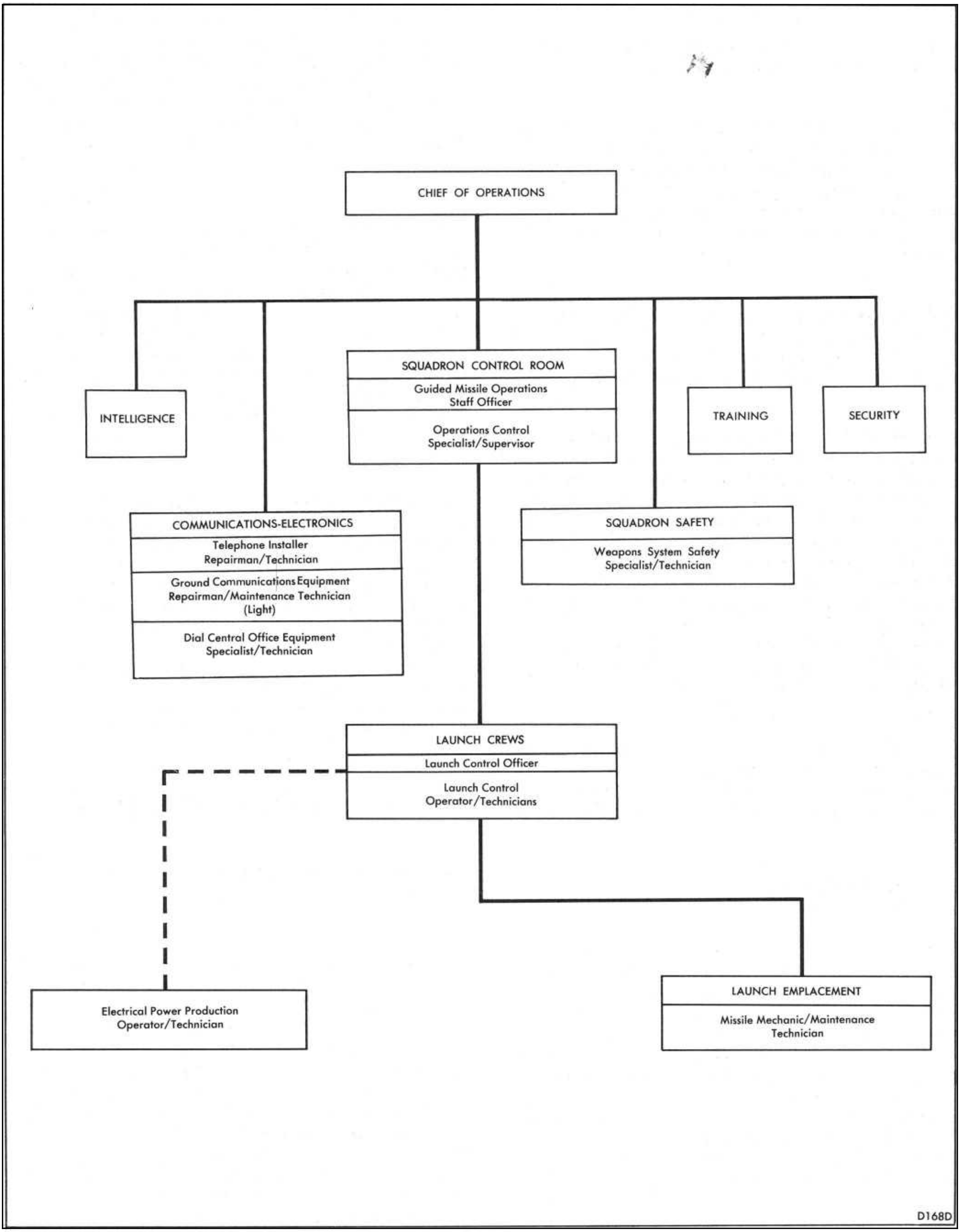


Figure 1-5. Operations Personnel Organization Chart

(Continued from Page 1-3)

vides staff supervision for training activities with simulation equipment assigned to the squadron.

1-28. Squadron Safety Section. This section is directed by the missile safety officer. He establishes and conducts ground safety programs, including formulation of safety policies and procedures. He investigates accidents and hazardous conditions, he also promotes safety consciousness amoung all personnel within the squadron.

1-29. Security Section. This section is directed by the air police officer. He is responsible for guarding all approaches to the squadron. Internal security is under the jurisdiction of the support base commander.

1-30. MAINTENANCE. The chief of maintenance is the highest technical authority in the squadron. It is his responsibility to see that a maximum number of missiles is maintained in combat-ready condition. He is directly assisted by a maintenance control officer who manages maintenance activity through the following sections: Analysis, Records, and Reports; Job Control; Maintenance Training (Standardization Team); and Quality Control. The actual maintenance activity involving system hardware is performed by the following sections (figure 1-6): Recycle (Periodic) Maintenance; Mobile Maintenance; Bench Maintenance; and Missile and Ground Support Equipment Maintenance.

1-31. Maintenance Supply. The Maintenance Supply Section is directed by the supply officer. Although most of the personnel work is on an 8-hour, 5-day basis the section is operated on a 24-hour, 7-day basis.

1-32. SQUADRON ARRANGEMENT.
(See figure 1-7.)

1-33. A squadron area encompasses the following: five launch positions, a RIM building, a liquid oxygen generating plant, and a surveillance and inspection area. The RIM building is located at an approximate midpoint between the launch positions. The launch positions, each consisting of three emplacements and a control area, are located according to strategic considerations. The distance between a launch position and the RIM building may be as much as 50 miles. A system of roads and communications networks connect all squadron installations.

1-34. LAUNCH POSITION. A launch position (figure 1-8) comprises three launch emplacements and a launch control area. The launch emplacements are located not more than 1500 feet from the launch control area and are positioned according to terrain and target considerations. Roads connect the launch emplacements and the launch control area. Electrical cables for power, launch control functions, and communications extend from the launch control area to each launch emplacement.

1-35. LAUNCH CONTROL AREA. A launch control area (figure 1-9) contains the equipment necessary to provide electrical power to launch emplacements, and to control the launching. The electrical power generating equipment consists of three diesel engine generator sets. A diesel fuel storage tank supplies fuel to the individual tanks of the engine generator sets. Electrical power is distributed through a trailer-mounted power switchboard. The launching control group is contained in a trailer manned by a launch control officer and three launch control operator/technicians.

1-36. LAUNCH EMPLACEMENT. A launch emplacement (figure 1-10) comprises the facilities and ground support equipment (excluding the launch control area) missile. The launch emplacement occupies an area of abount 450 square feet and is laid out in the form of a cross. The arm of the cross is made up of the tanks and plumbing of the propellant transfer system. The erecting-launching mount is at the center of the cross. The longer extension of the cross is a trackway for removal of the panelized building. When in the horizontal position, the missile occupies the area that forms the shorter, or downrange portion of the cross.

1-37. DELIVERY-TO-IMPACT SEQUENCE.

1-38. RECEIPT AND INSPECTION.
(See figures 1-11, 12, and 13.)

1-39. The missile and the re-entry vehicle are shipped separately to an airstrip near the RIM building. The missile is unloaded under the supervision of the aircraft loadmaster but when removed becomes the responsibility of the squadron. After unloading, the missile is transferred from the front trailer dolly and the rear trailer dolly to the erecting-transport boom (supported by the rear trailer dolly). The erecting-transporting boom is towed to the RIM building by a prime mover. The re-entry vehicle is towed to the surveillance and inspection building on the re-entry vehicle trailer. Security regulations, under the direction of the air police officer, are observed during all transporting operations.

(Continued on Page 1-12)

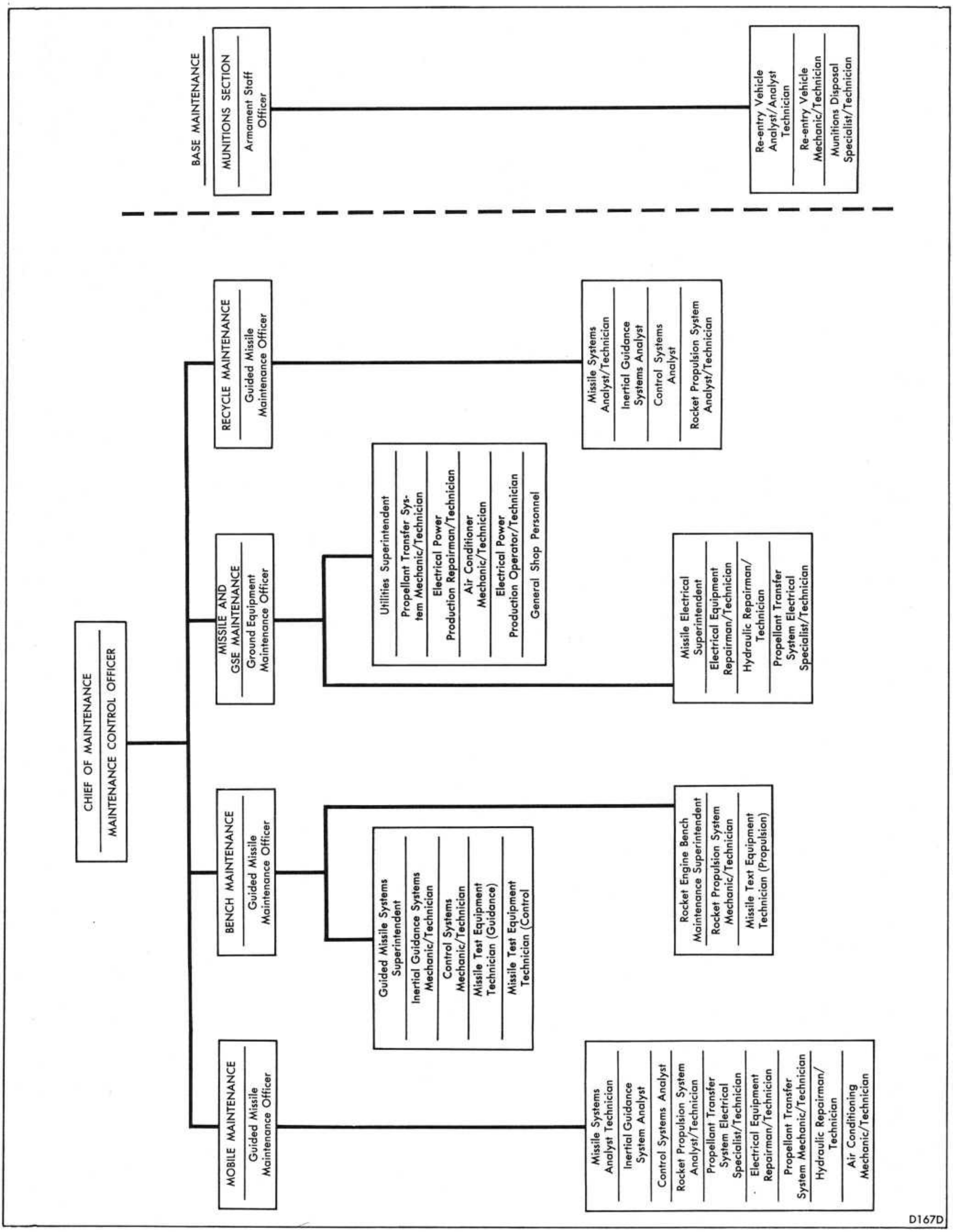


Figure 1-6. Maintenance Personnel Organization Chart

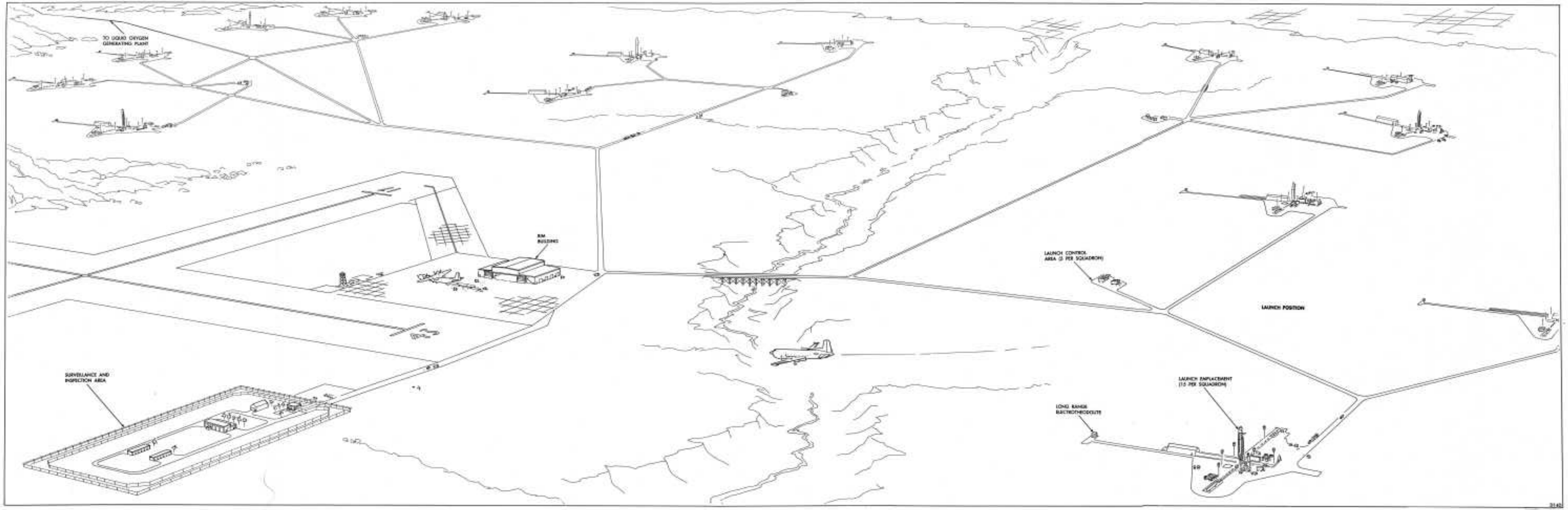


Figure 1-7. Squadron Area

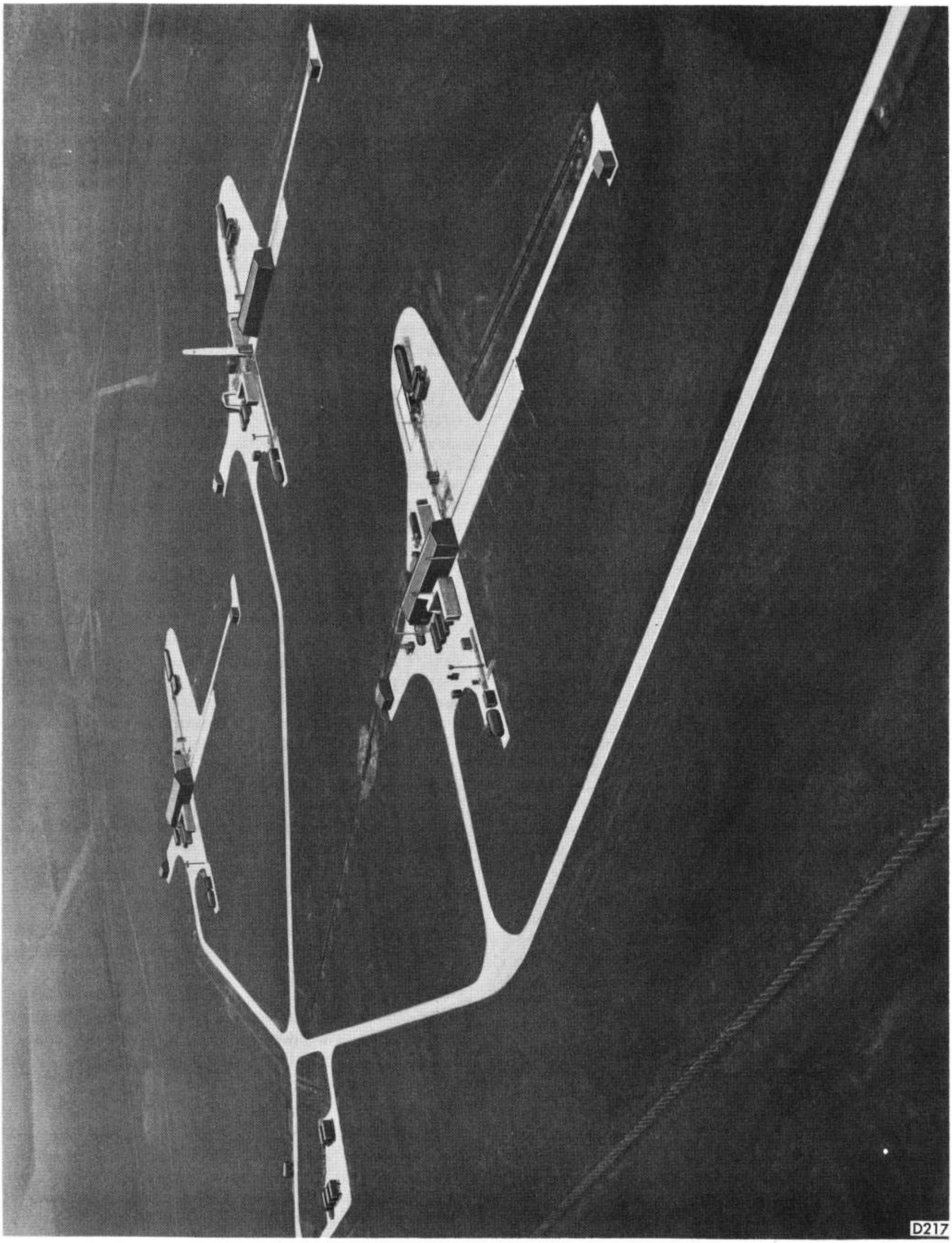


Figure 1-8. Launch Position

(Continued from Page 1-8)

1-40. Power from the transportation protection kit (figure 1-12) must be supplied to the gyro heaters of the guidance system enroute, because the gyros are mounted in a lubricant that tends to solidify at ordinary temperatures.

1-41. The erecting-transporting boom is positioned in the missile maintenance area of the RIM building. The forward landing gear is lowered and the prime mover is disconnected. RIM building power is now supplied to the gyro heaters, so the transportation protection kit can be removed from the missile. The exterior of the missile is inspected for damage. Access doors are opened and a visual inspection is made of the missile interior.

1-42. RIM BUILDING CHECKOUT. Before the missile is checked out, the checkout equipment itself is functionally checked by connecting it to an umbilical simulator which simulates the functions of the missile electrical systems. The equipment checked consists of the missile checkout station, the missile launching simulator, and the trailer-mounted air conditioner. After this checkout equipment has been proved functional, it is disconncted from the umbilical simulator and connected to the missile by cables, ducts, and hoses. Consoles within the trailers are used to check the propulsion, guidance, and flight control systems of the missile.

1-43. System checkouts demonstrate that all electrical systems are operative, pressurized systems operate within prescribed leak limits, the sequence of automatic operations is correct, and the systems respond correctly to insertion of specific test information. If a malfunction is detected by the checkout procedures, the source of the trouble is determined and corrected. After all the systems have been individually checked, an integrated system checkout is performed.

1-44. Repairs too complex to be made in the missile maintenance area are made in the bench repair shops (figure 1-3). Bench repair shops are provided in the RIM building for the flight control system, the guidance system, and the rocket engine propulsion system.

1-45. TRANSFER TO LAUNCH EMPLACEMENT. When all checkouts are completed and all necessary repairs and adjustments have been made, the transportation protection kit is reinstalled (figure 1-11), and the missile is moved to the launch emplacement (figure 1-12) where the electrical functions of all GSE launching equipment have been previously checked by use of the umbilical simulator.

1-46. MISSILE MATING TO ERECTING-LAUNCHING MOUNT. At the launch emplacement, the panelting-transporting boom is pulled into position and the ized building is retracted (figure 1-12) and the erecting-transporting boom, with the missile aboard, is maneuvered into position for joining the erecting-launching mount lower base. The prime mover is disconnected, driven away, and the missile aligned to the erecting-launching mount launch legs. The erecting-transporting boom is pulled into position and the missile is attached to the launch legs. The missile is then connected to GSE by the umbilical cables, and erected for final adjustment of the erecting-launching mount (figure 1-14). Vertical leveling is accomplished by use of erecting-launching mount leveling jacks. After completion of the leveling process, the missile is lowered, the panelized building is moved to its standby position, and the missile is ready for mating with the re-entry vehicle.

1-47. RE-ENTRY VEHICLE PREPARATION AND CHECKOUT. When the re-entry vehicle arrives at the surveillance and inspection building it is visually inspected and tested. When tests are completed, the warhead is installed. The assembled re-entry vehicle and warhead then undergo a final checkout, using the final assembly test set.

1-48. FINAL ASSEMBLY AND CHECKOUT. Upon completion of the functional checkout in the SI building, the assembled re-entry vehicle and warhead are transported to the launch emplacement on the re-entry vehicle lift trailer, and installed on the missile guidance section. The missile is then prepared for another checkout of its individual systems. Individual checkouts are followed by an integrated system checkout. The missile and its GSE are then placed in a ready condition, but to insure overall system reliability, this ready condition is followed by exercise countdowns. First a dry exercise is performed. During a dry exercise no propellants are transferred and signals that would arise from propellant flow are simulated. The missile and GSE are returned to ready condition in preparation for a wet exercise. During a wet exercise the propellant transfer system undergoes actual loading. Following the wet exercise and return of the propellants to their storage tanks, the propellant transfer system is purged as necessary, and the missile and its GSE are placed in a ready condition for launch countdown. In checkout environment, a dummy warhead may be used as a substitute during wet or dry countdown exercises. This allows a more extensive checkout of the missile system.

1-49. MAINTENANCE. In addition to periodic maintenance, daily operational checks are performed by the launch position personnel. Repair and specialized maintenance requirements discovered during the daily checks are met by mobile maintenance teams from the RIM building.

(Continued on Page 1-19)

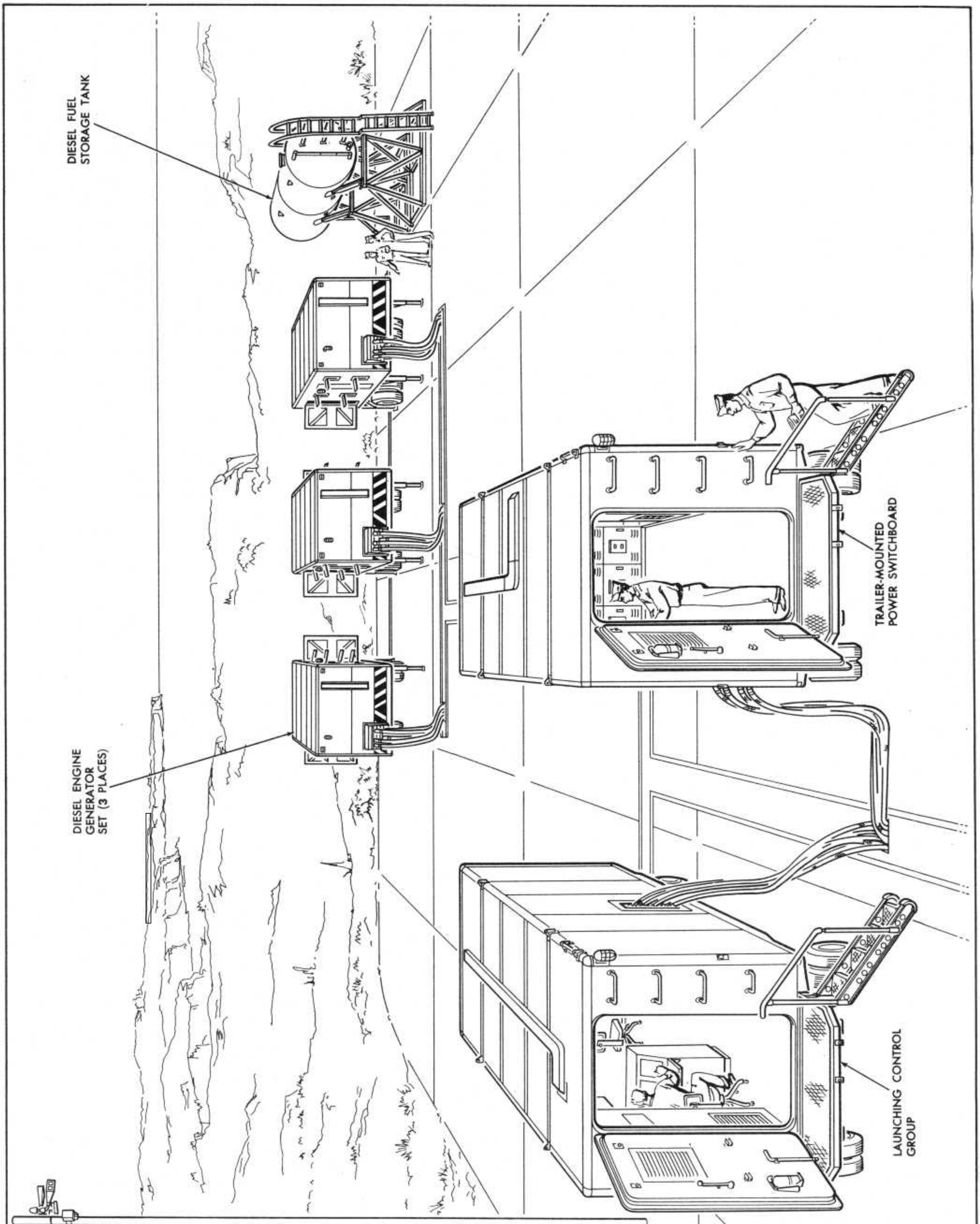


Figure 1-9. Launch Control Area (Typical)

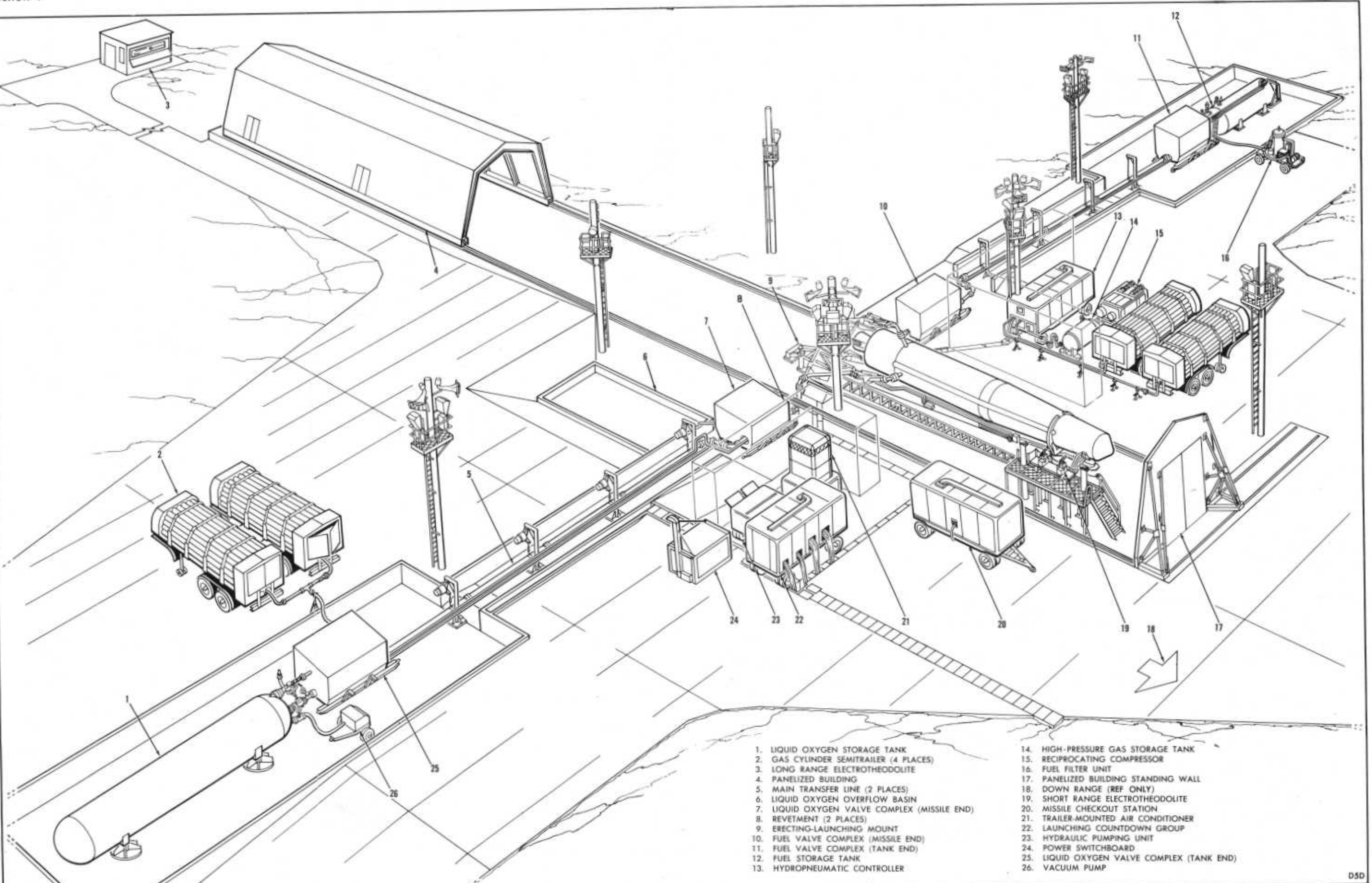


Figure 1-10. Launch Emplacement and Ground Support Equipment

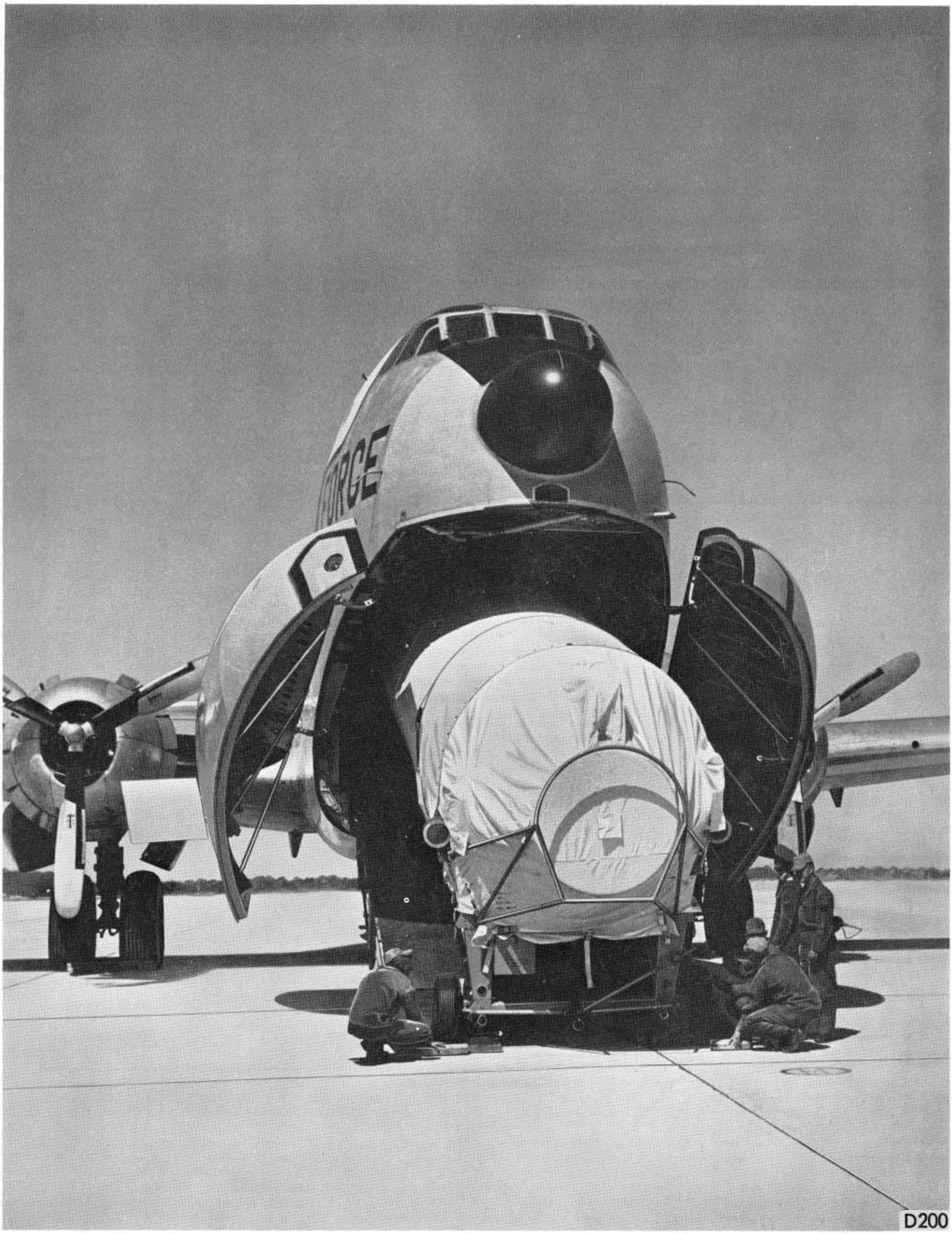


Figure 1-11. SM-75 Missile Delivery

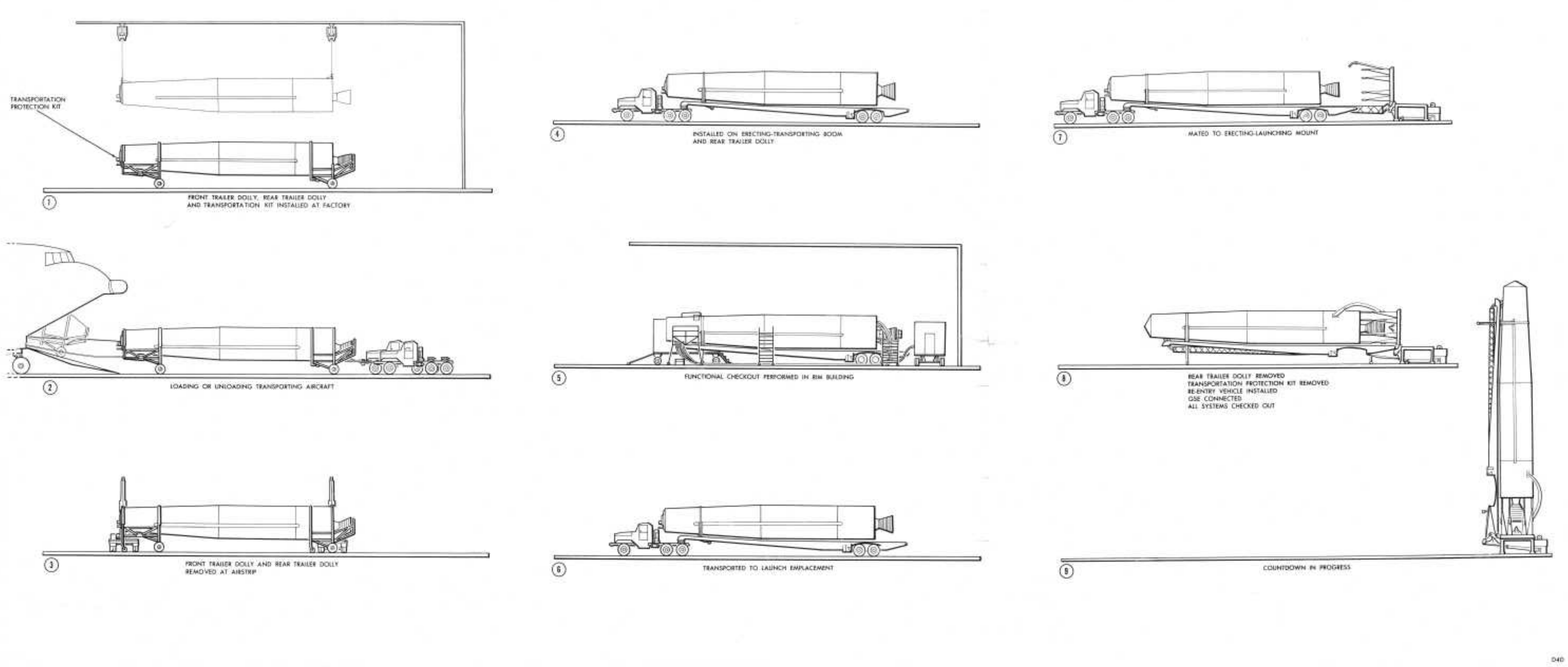


Figure 1-12. Delivery-to-Launch Sequence

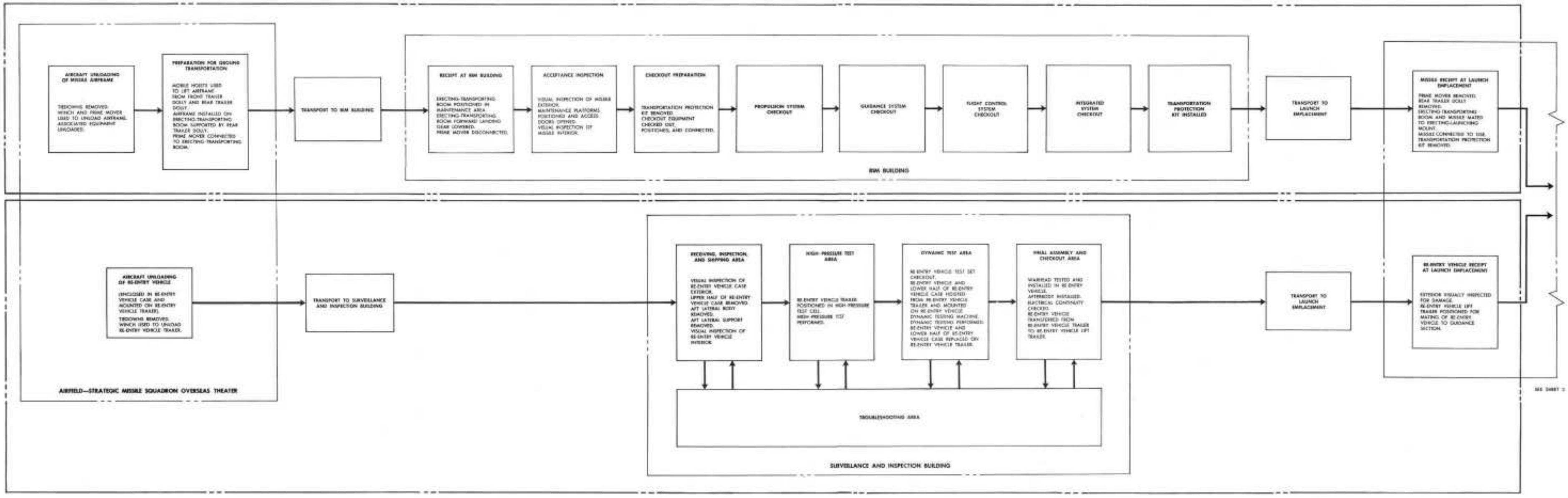


Figure 1-13. Missile Receipt to Launch—Block Diagram (Sheet 1 of 2)

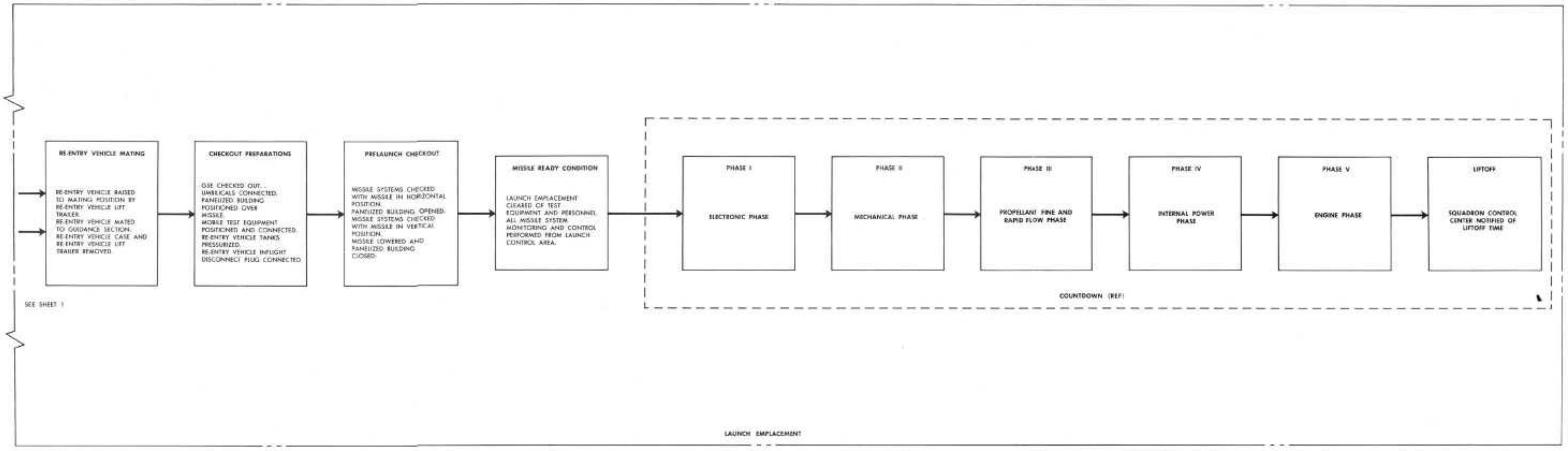


Figure 1-13. Missile Receipt to Launch — Block Diagram (Sheet 2 of 2)

(Continued from Page 1-12)

1-50. COUNTDOWN.

1-51. A launch countdown consists of a sequence of automatic operations preceding the actual launching of the missile. This sequence is divided into five phases.

1-52. If a subsystem malfunctions at any time during the countdown, lights on the launch control operation technician launch monitor console indicate both a malfunction and a technical hold. This equipment-imposed technical hold stops the countdown at the end of the phase during which the malfunction occurs (or in some cases immediately) and prevents initiation of the next phase. Except for certain hold conditions that may occur during phase V, the countdown automatically resumes as soon as the malfunction is corrected.

1-53. As an additional precautionary measure, a launch control operator/technician can impose or sustain a technical hold by manually operating the technical hold switch which arrests the automatic countdown sequence. When the malfunction is corrected, the manual technical hold is removed and the countdown continues. For tactical reasons, an operational hold can be initiated from the officer launch console at any time during phase I or phase II. The actual occurrence of the operational hold will be at the end of phase II.

1-54. If an emergency arises, a stop can be imposed from the officer launch console. The firing is then aborted, and the missile defueled, and the weapon system returned to standby condition.

1-55. The missile propellant tanks are empty at all times except during wet exercises and countdown. Propellant storage tanks, compressed gaseous nitrogen, and pipeline outfits provide the means for automatically loading the missile at the proper time.

1-56. During countdown, as well as in standby condition, a trailer-mounted air conditioner supplies conditioned air to those areas in the missile which require control of air temperature and humidity for operating efficiency.

1-57. The launch countdown consists of a preparatory stage (sheet 1, figure 1-15) and a series of automatic steps divided into five phases, each of which must be completed before the next phase begins. The engine generator sets (sheet 2, figure 1-15) are started prior to countdown by a switch on the officer launch console. One generator set is required on the line before countdown may be started. The three engine generator sets come up to operating speed, automatically synchronize, and switch to the main bus within 1 minute after the generator start switch is actuated.

1-58. PHASE I. (See sheet 2, figure 1-15.) The missile and GSE power supplies required to start the automatic sequence of the system are switched on; propellant valves, and corresponding relays are monitored for initial position and igniter links checked; missile air-conditioning circuitry is checked for continuity, and montored, CEA is turned on and missile hydraulics is applied at 3000 psi; missile engines are centered; re-entry vehicle is prepared; the guidance system is aligned to preset target values; the fuel circulating pump is turned on and missile bottles are pressurized to 3000 psi; the missile liquid oxygen tank vent valve is opened. This ends phase I and starts phase II.

1-59. PHASE II. (See sheet 3, figure 1-15.) In phase II the following functions occur: the liquid oxygen storage tank is pressurized; the panelized building is fully retracted; simultaneously, the flight control system is checked by slewing the engines on external power. After the panelized building is retracted to the 93-foot position and the external slew check has been completed, the missile is erected. This ends phase II and starts phase III.

1-60. PHASE III. (See sheets 3 and 4, figure 1-15.) Phase III functions occur as follows: rapid loading of liquid oxygen to the 95 percent full level and simultaneous filling of the fuel line by fine loading; fuel circulating pump is turned off; rapid loading of fuel into the missile and the fuel loading computer counts; loading fuel to the 100 percent full level, missile fuel tank pressurization; clamshells are opened and launch pins are retracted; erector is lowered. This ends phase III and starts phase IV.

1-61. PHASE IV. (See sheets 4 and 5, figure 1-15.) Phase IV functions occur as follows: missile inverter is turned transfer of all missile power to internal; missile battery trickle charger is disconnected; slewing the engines on internal power; checks for: TARGET CHANGE — TARGET SELECTED switch set to TARGET SELECTED, and WAR — PEACE switch previously set to WAR. This ends phase IV and starts phase V.

1-62. PHASE V. (See sheets 5 and 6, figure 1-15.) Phase V functions occur as follows: activation of the re-entry vehicle batteries; loading of liquid oxygen into the missile from 95 to 100 percent; pressurization of the missile liquid oxygen tank and missile start tanks; start of the engine fire sequence, which launches the missile.

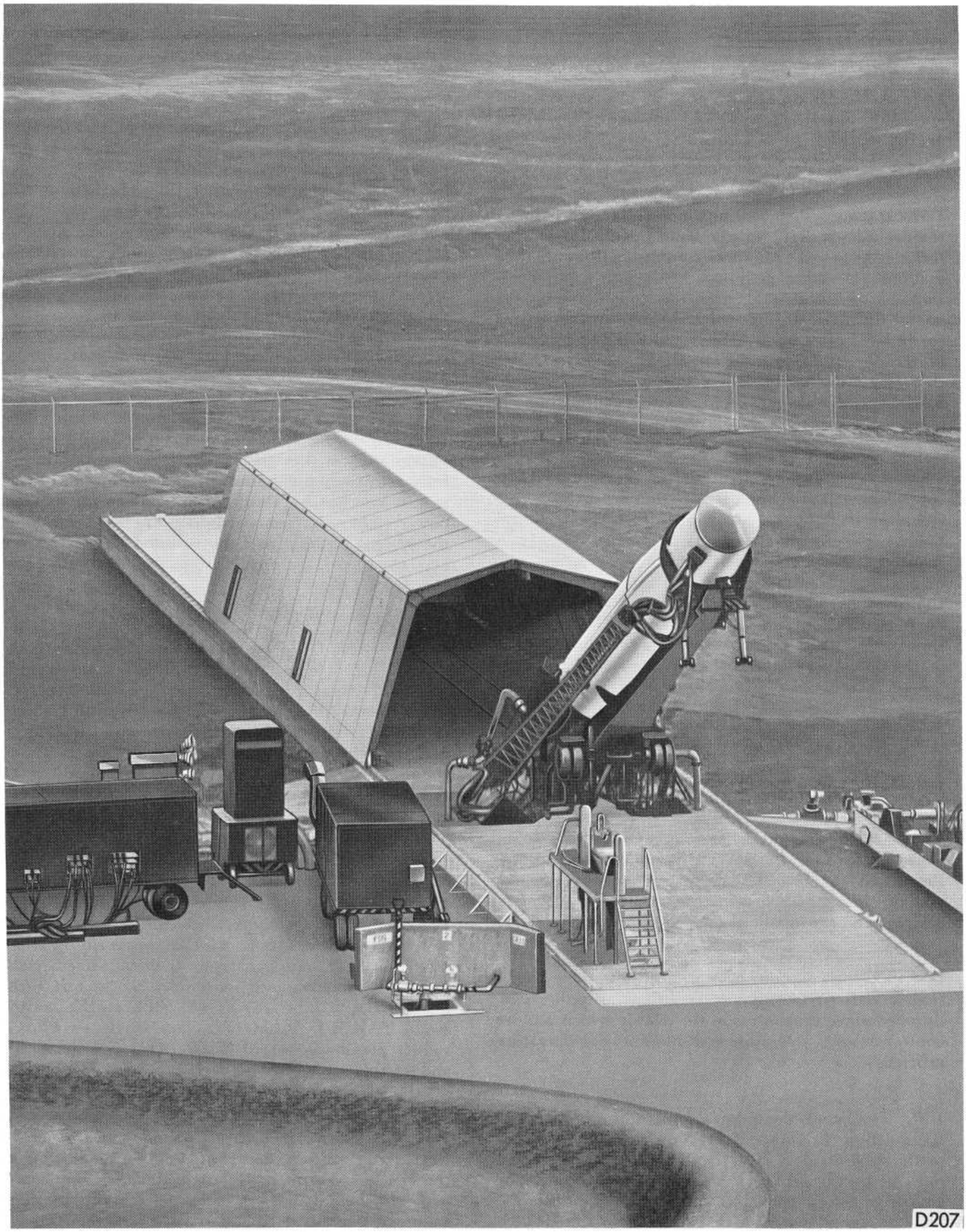


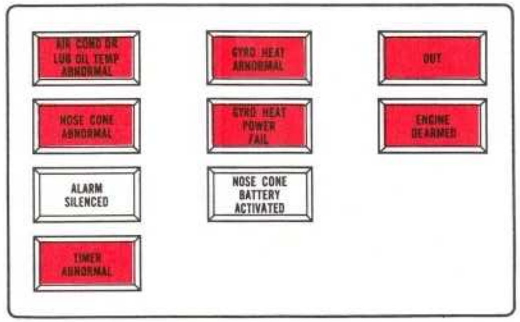
Figure 1-14. Erecting-Launching Mount Checkout During Installation

NOTE

1. THERE IS ONLY ONE MALFUNCTION INDICATOR LIGHT AND ONE TECH HOLD INDICATOR LIGHT FOR EACH LAUNCH EMPLACEMENT. THE DUPLICATIONS ON THIS ILLUSTRATION ARE ONLY TO INDICATE THE DIFFERENT OPERATIONS THAT WILL CAUSE A MALFUNCTION AND/OR TECHNICAL HOLD.

2. THERE IS ONLY ONE PROCEEDING INDICATOR LIGHT FOR EACH LAUNCH EMPLACEMENT. THE DUPLICATIONS ON THIS ILLUSTRATION INDICATE THE DIFFERENT CONDITIONS UNDER WHICH THE PROCEEDING INDICATOR LIGHT WILL COME ON.

3. SINGLE LINED BLOCKS INDICATE FUNCTIONS. DOUBLE LINED BLOCKS ARE COLORED REPRODUCTIONS OF PANEL LIGHT INDICATORS.



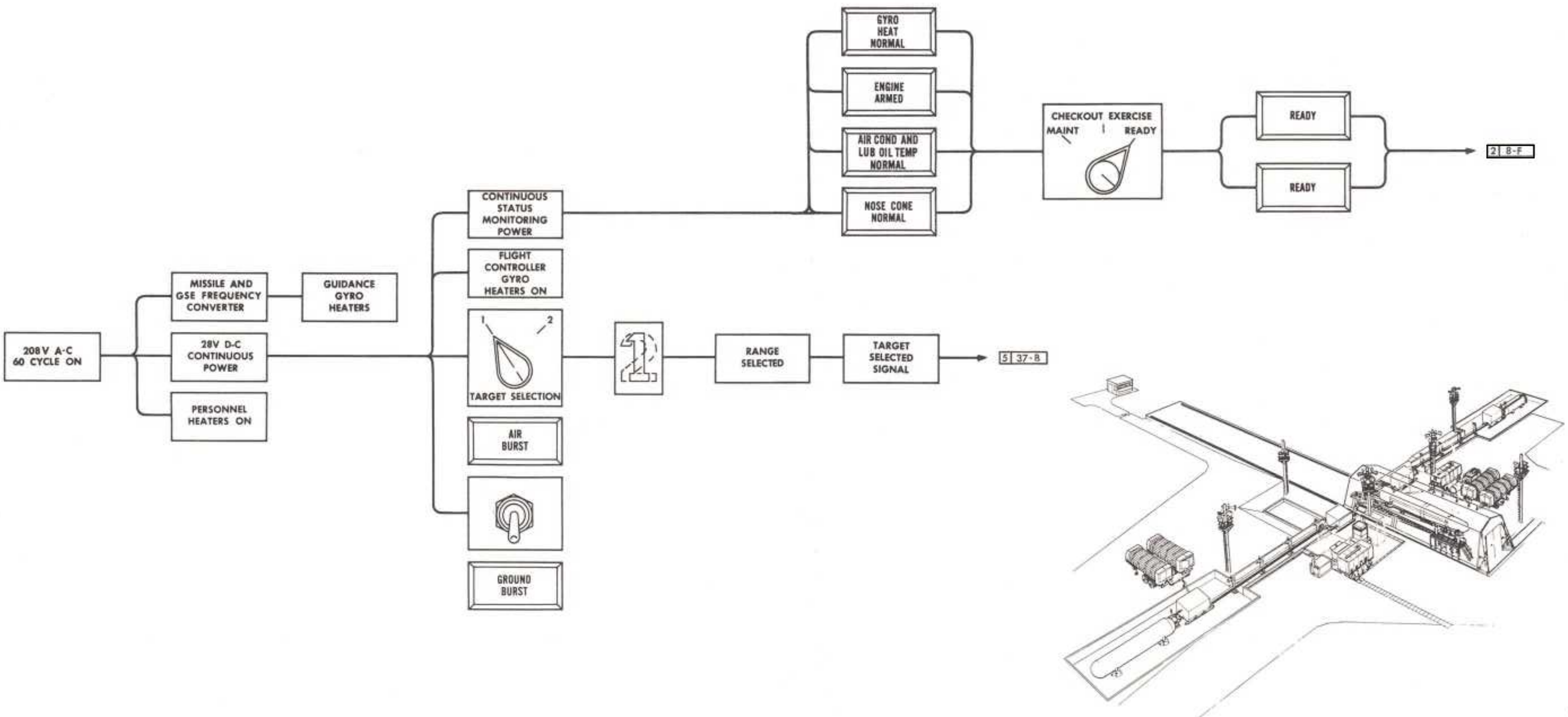


Figure 1-15. Launch Countdown — Data Flow (Sheet 1 of 6)

NOTE

1. THERE IS ONLY ONE MALFUNCTION INDICATOR LIGHT AND ONE TECH HOLD INDICATOR LIGHT FOR EACH LAUNCH EMPLACEMENT. THE DUPLICATIONS ON THIS ILLUSTRATION ARE ONLY TO INDICATE THE DIFFERENT OPERATIONS THAT WILL CAUSE A MALFUNCTION AND/OR TECHNICAL HOLD.
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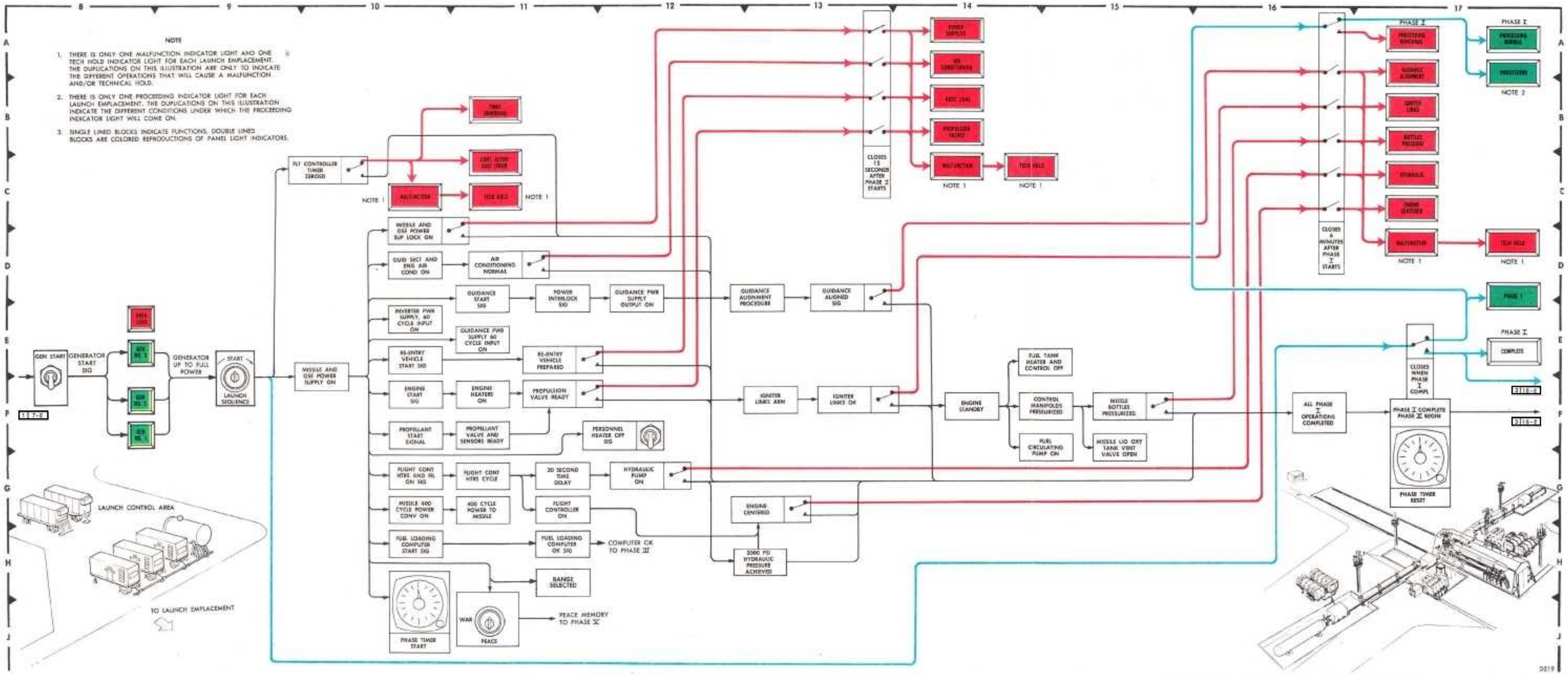


Figure 1-15. Launch Countdown — Data Flow (Sheet 2 of 6)

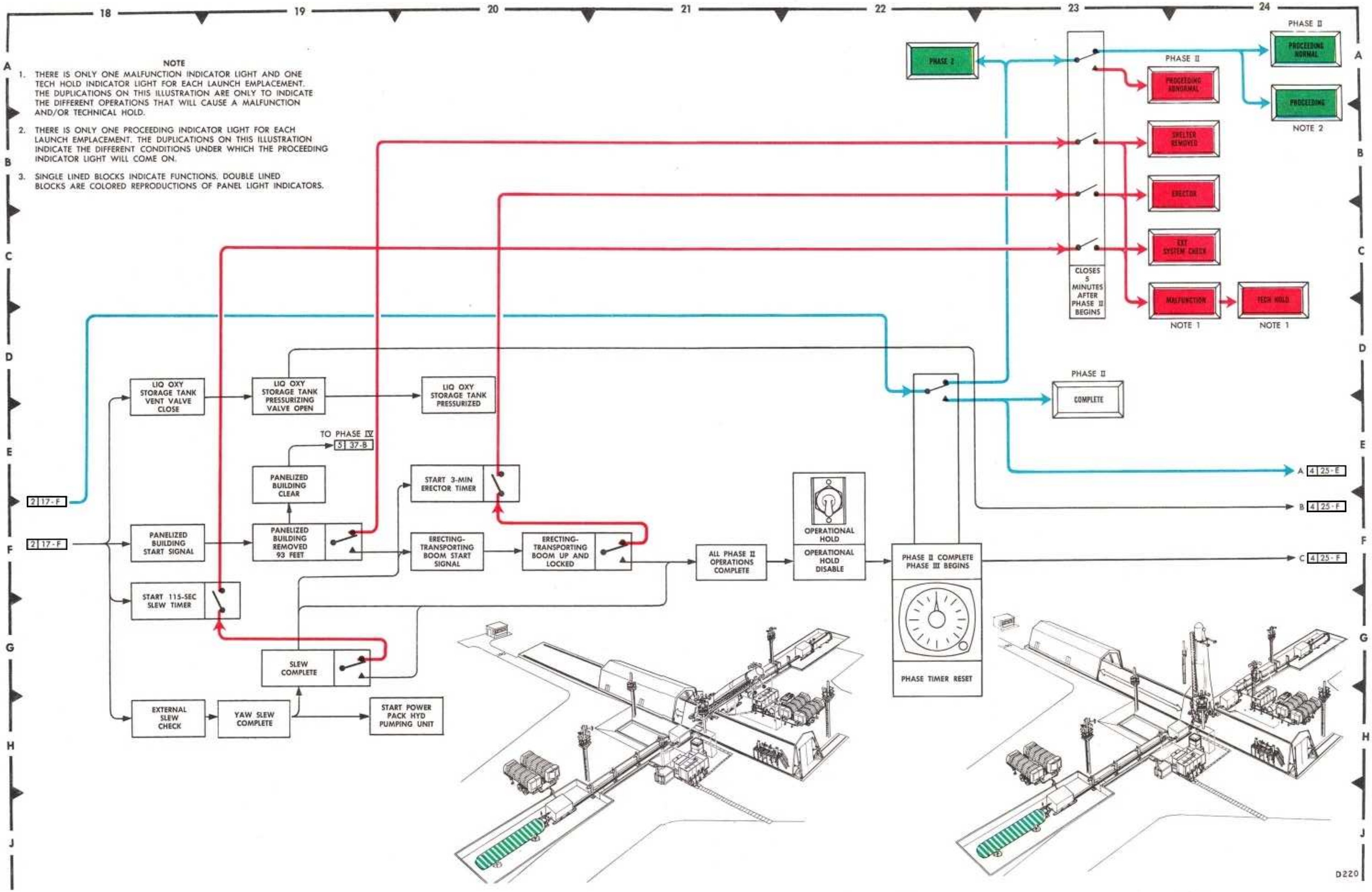
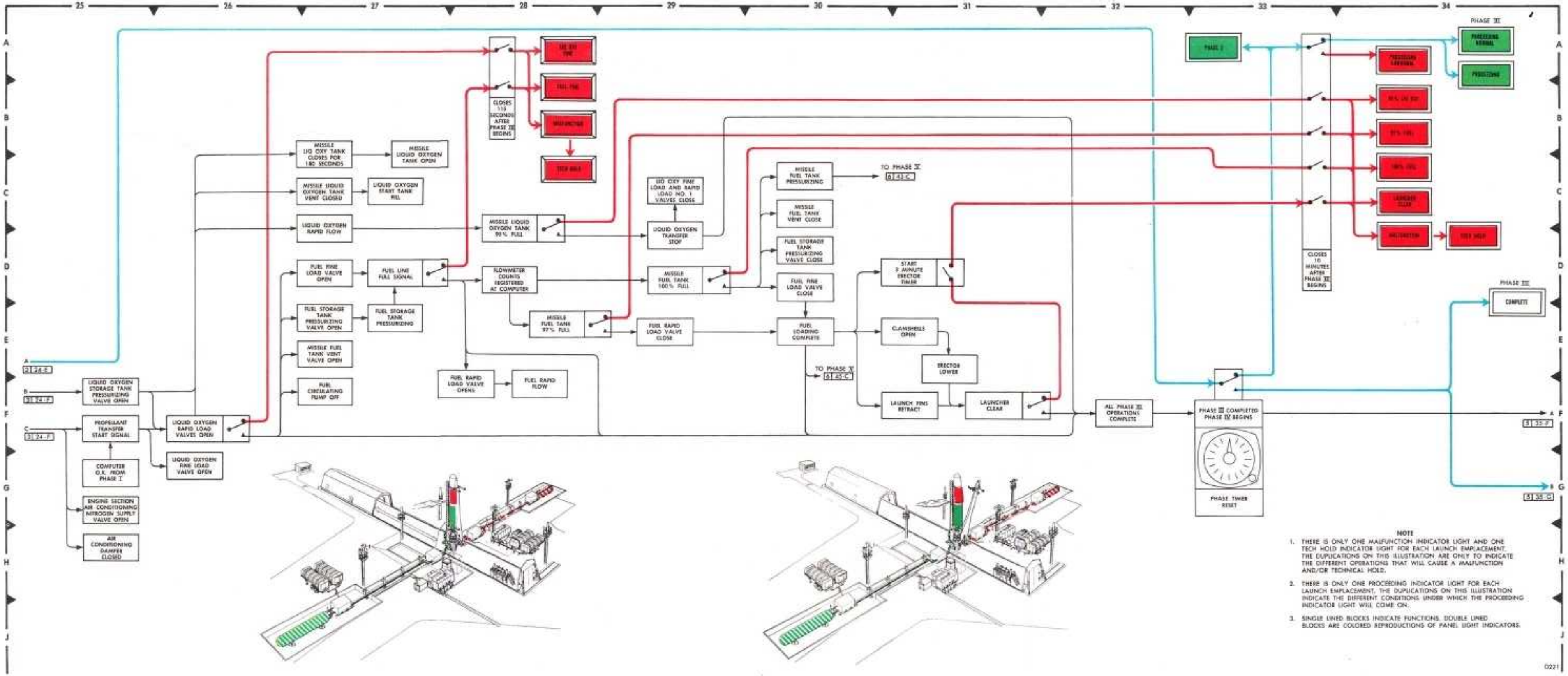


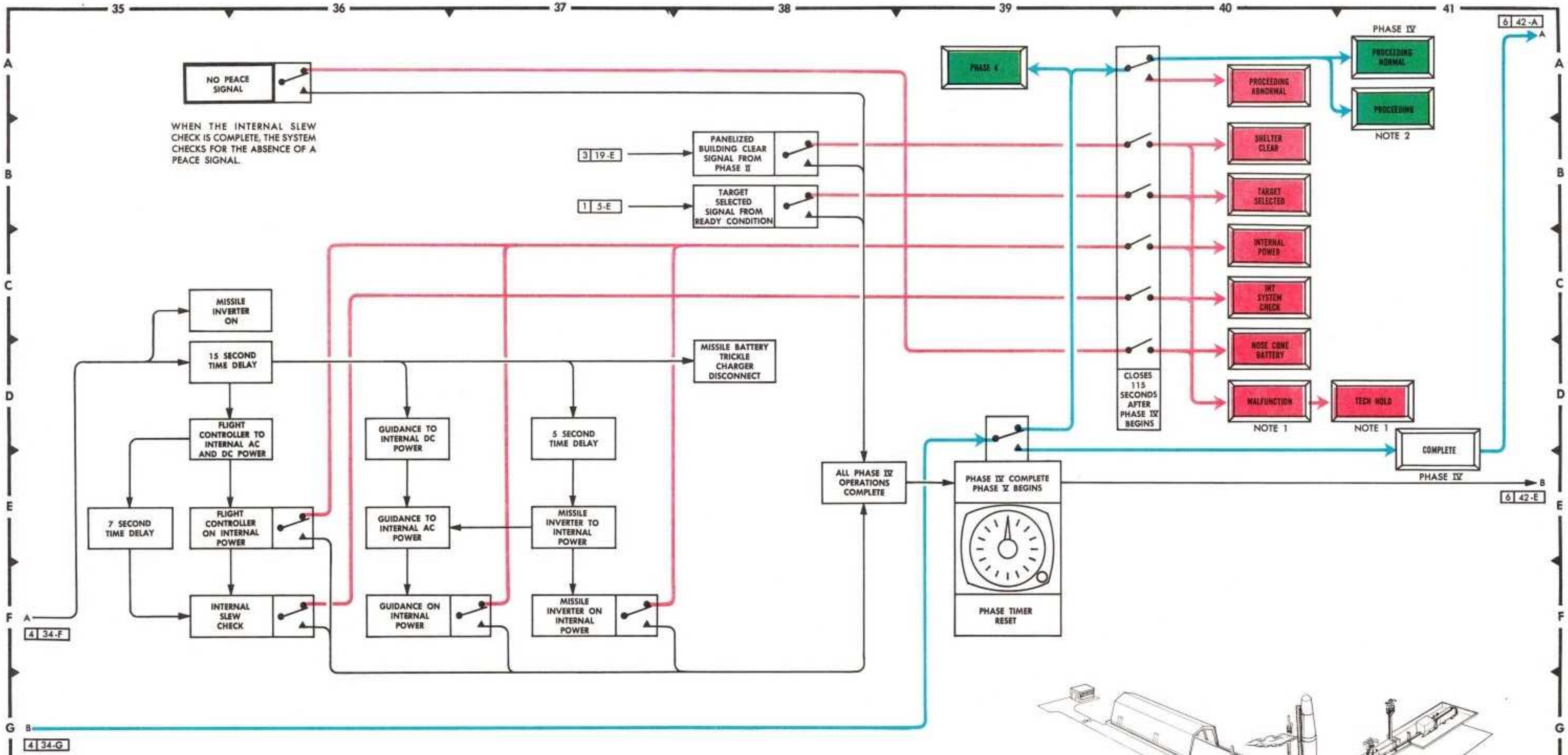
Figure 1-15. Launch Countdown — Data Flow (Sheet 3 of 6)

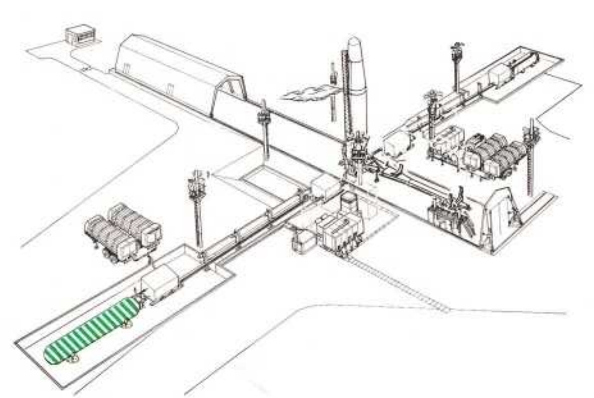


NOTE

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3. SINGLE LINED BLOCKS INDICATE FUNCTIONS. DOUBLE LINED BLOCKS ARE COLORED REPRODUCTIONS OF PANEL LIGHT INDICATORS.

Figure 1-15. Launch Countdown—Data Flow (Sheet 4 of 6)





NOTE

1. THERE IS ONLY ONE MALFUNCTION INDICATOR LIGHT AND ONE TECH HOLD INDICATOR LIGHT FOR EACH LAUNCH EMPLACEMENT. THE DUPLICATIONS ON THIS ILLUSTRATION ARE ONLY TO INDICATE THE DIFFERENT OPERATIONS THAT WILL CAUSE A MALFUNCTION AND/OR TECHNICAL HOLD.
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3. SINGLE LINED BLOCKS INDICATE FUNCTIONS. DOUBLE LINED BLOCKS ARE COLORED REPRODUCTIONS OF PANEL LIGHT INDICATORS.

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Figure 1-15. Launch Countdown — Data Flow (Sheet 5 of 6)

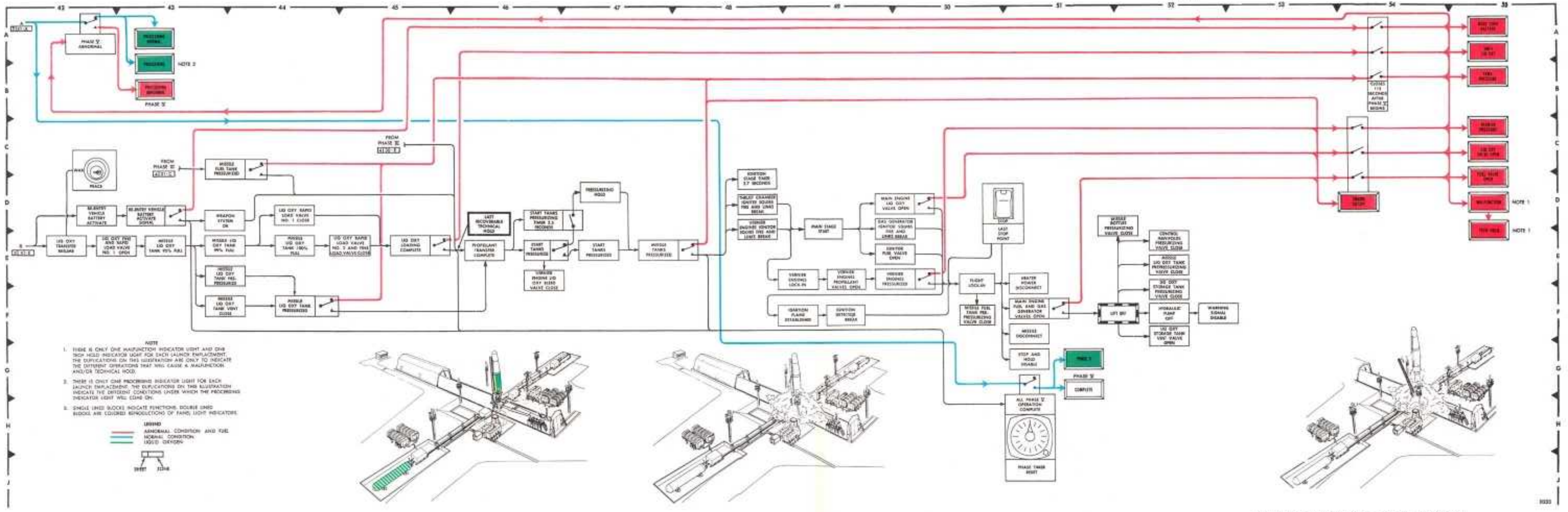


Figure 1-15. Launch Countdown – Data Flow (Sheet 6 of 6)

SECTION II

POWER GENERATION AND DISTRIBUTION SYSTEMS

2-1. PURPOSE.

2-2. The power generation and distribution systems provide electrical power for the launch position facilities and the RIM building facility. In areas of the weapon system where continuous power is required, emergency power is available at all times.

2-3. DESCRIPTION.

2-4. There are six power generation and distribution systems in the squadron. One of these systems provides electrical power for the RIM building and its immediate vicinity. The five other systems are identical and consist of a launching control group, trailer-mounted power switchboard, three diesel engine generator sets, and a diesel fuel storage tank. Each of these systems supplies a launch position. The equipment in these systems is described in table 2-1.

Table 2-1. Power Generation and Distribution System Equipment at the Launch Positions

Equipment Name	*Index and Figure No.*	*Purpose*	*Characteristics*
Trailer-Mounted Launching Control Group A/M24A-2	5, 2-1	Provides a means of starting and monitoring power generation system automatically.	Van-type trailer, launch officer generator control panel, 120/208V a-c power distribution panel.
120/208V a-c power distribution panel	8, 2-1	Distributes electrical power within launching control group.	Console-mounted circuit breaker panel, molded-case circuit breakers with circuit designation placards.
Trailer-Mounted Diesel Engine Generator Set AF/M32A-12 (3 places)	9, 2-1 2-2	Produces electrical power for three launch emplacements.	Van-type trailer with removable front axle assembly, diesel engine, generator, generator control console.
Diesel engine	2-2	Produces mechanical power which drives generator.	Four-cycle, V-type, 12-cylinder, turbo-charged, 575 hp at 1800 rpm.
Generator	2-2	Generates electrical power.	Three-phase, 60-cycle, 480V a-c, 250 kilowatts at 1800 rpm.

(Continued on Page 2-3)

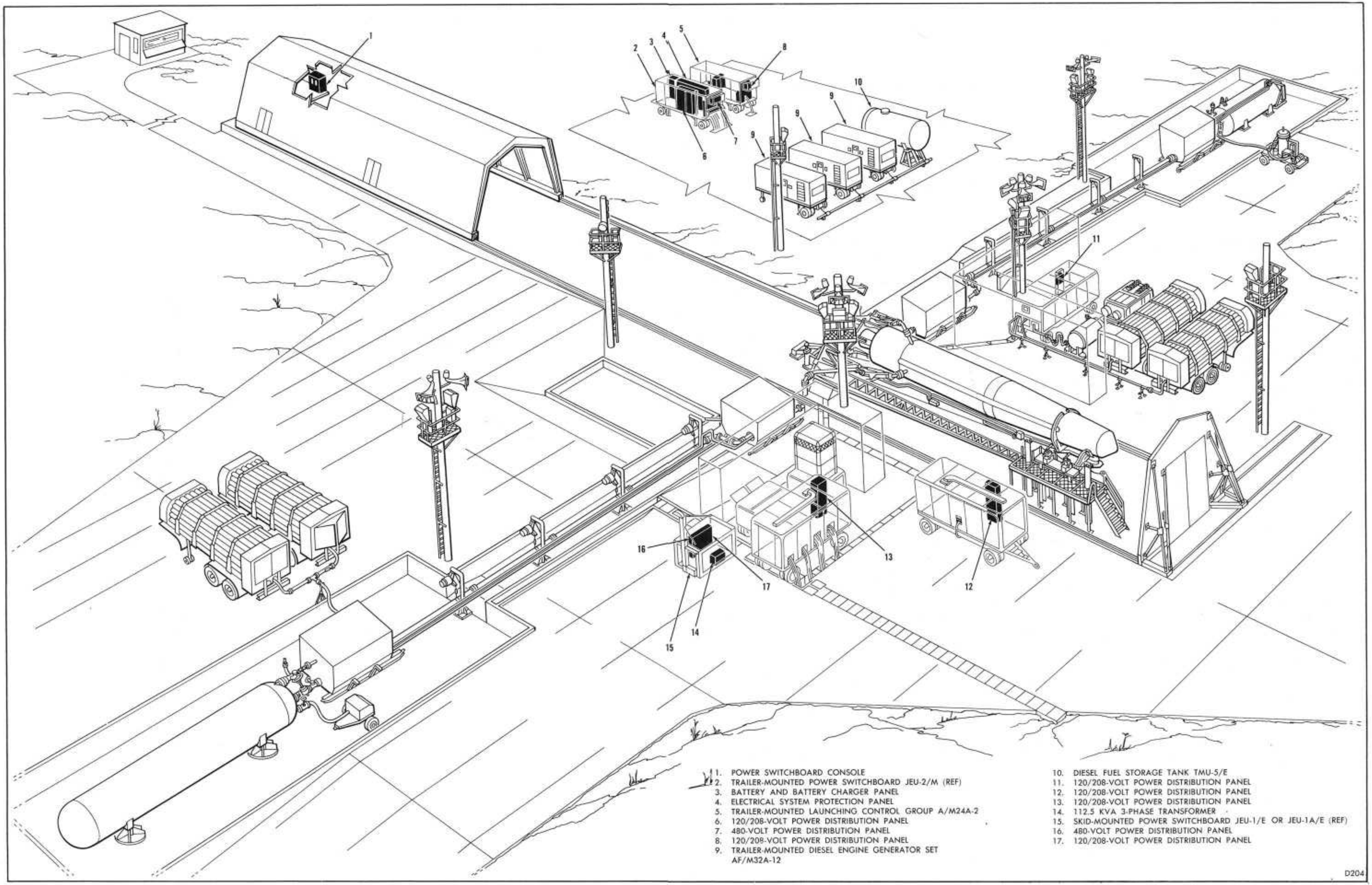


Figure 2-1. Launch Position Power Generation and Distribution System Components

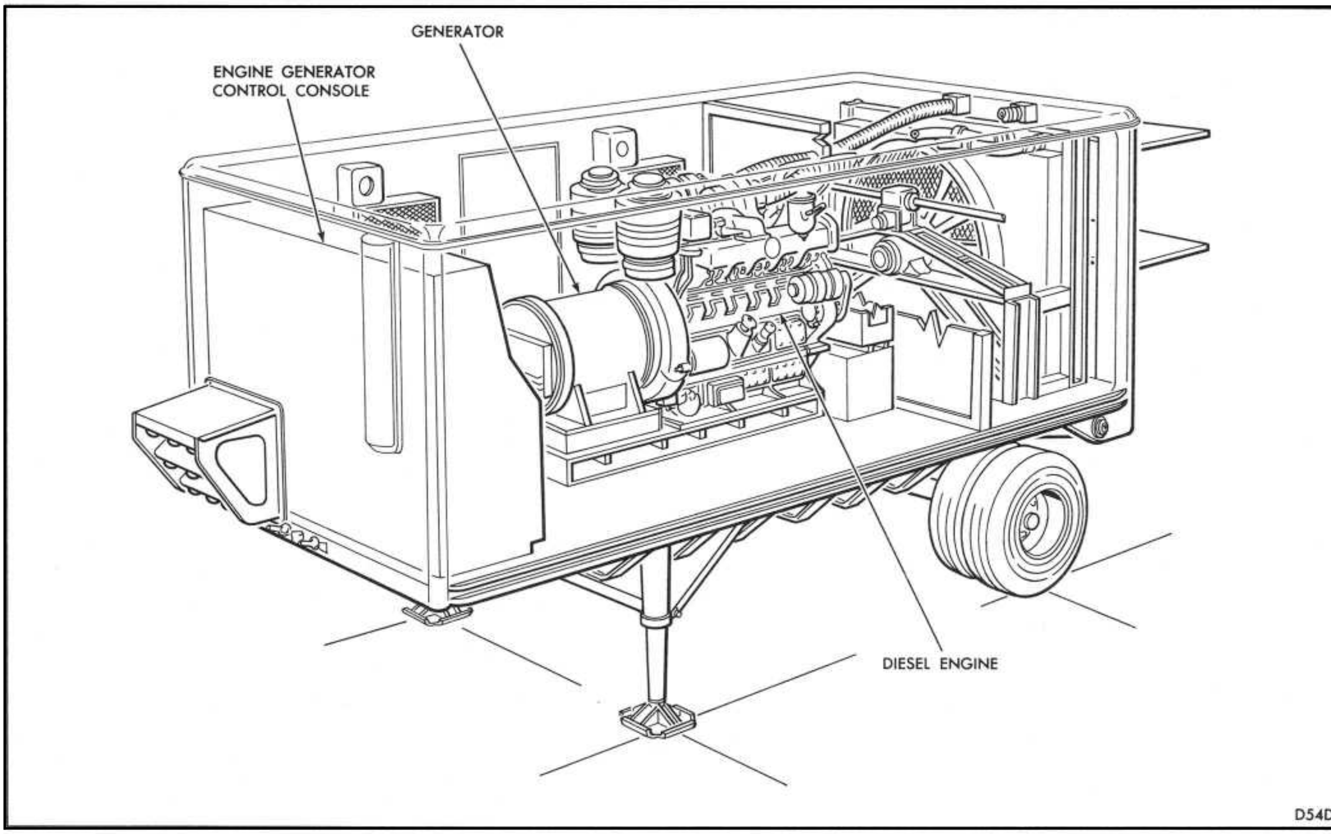


Figure 2-2. Interior View of Diesel Engine Generator Set

Table 2-1. Power Generation and Distribution System Equipment at the Launch Positions (Continued)

Equipment Name	Index and Figure No.	Purpose	Characteristics
Diesel Fuel Storage Tank TMU-5/E	10, 2-1	Stores fuel for diesel engine.	Stand-mounted cylindrical steel tank, 4000 gallon capacity, gravity-flow feeder system.
Trailer-Mounted Power Switchboard JEU-2/M	2, 2-1 2-3 2-4 2-5	Automatically synchronizes and parallels power output from diesel engine generator sets and distributes it to skid-mounted power switchboards at launch emplacements.	Van-type trailer, battery and battery charger panel, electrical systems protection panel, 480V a-c power distribution panel, 120/208V a-c power distribution panel.
Battery and battery charger panel	3, 2-1 2-5	Supplies trip circuit power to electrical system protection panel relays and 480V a-c power distribution panel circuit breaker coils.	Battery panel with four 12V batteries, a battery charger panel with a 56V, 3.0-amp output, meters, switches, and control knobs.
Electrical system protection panel.	4, 2-1 2-5	Provides for automatic or manual synchronization of power, and protects diesel engine generator sets and utility tie.	Meters, relays, control knobs, indicator lights, switches, placards; three-section, floor to ceiling panel.

(Continued on Page 2-7)

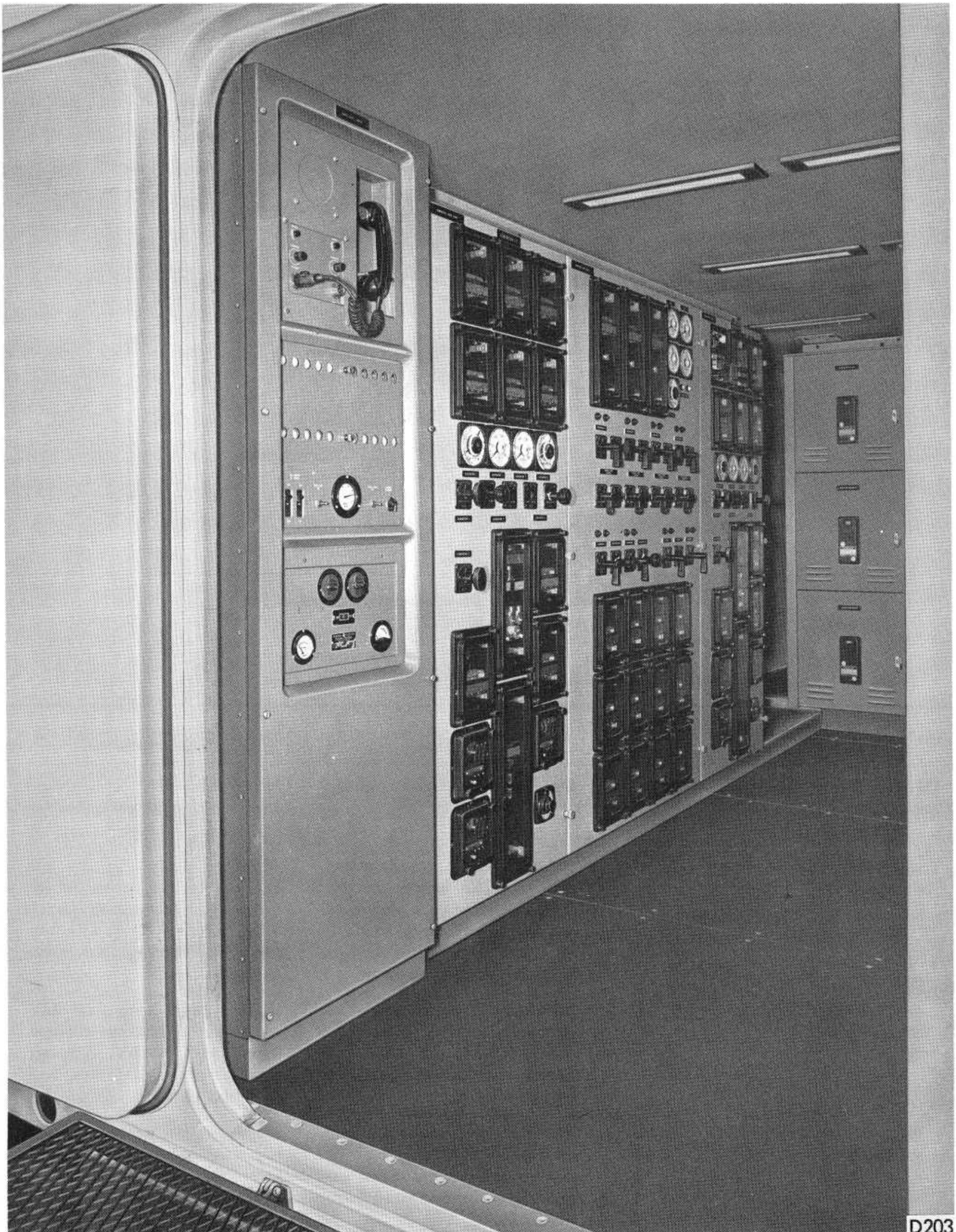


Figure 2-3. Trailer-Mounted Power Switchboard

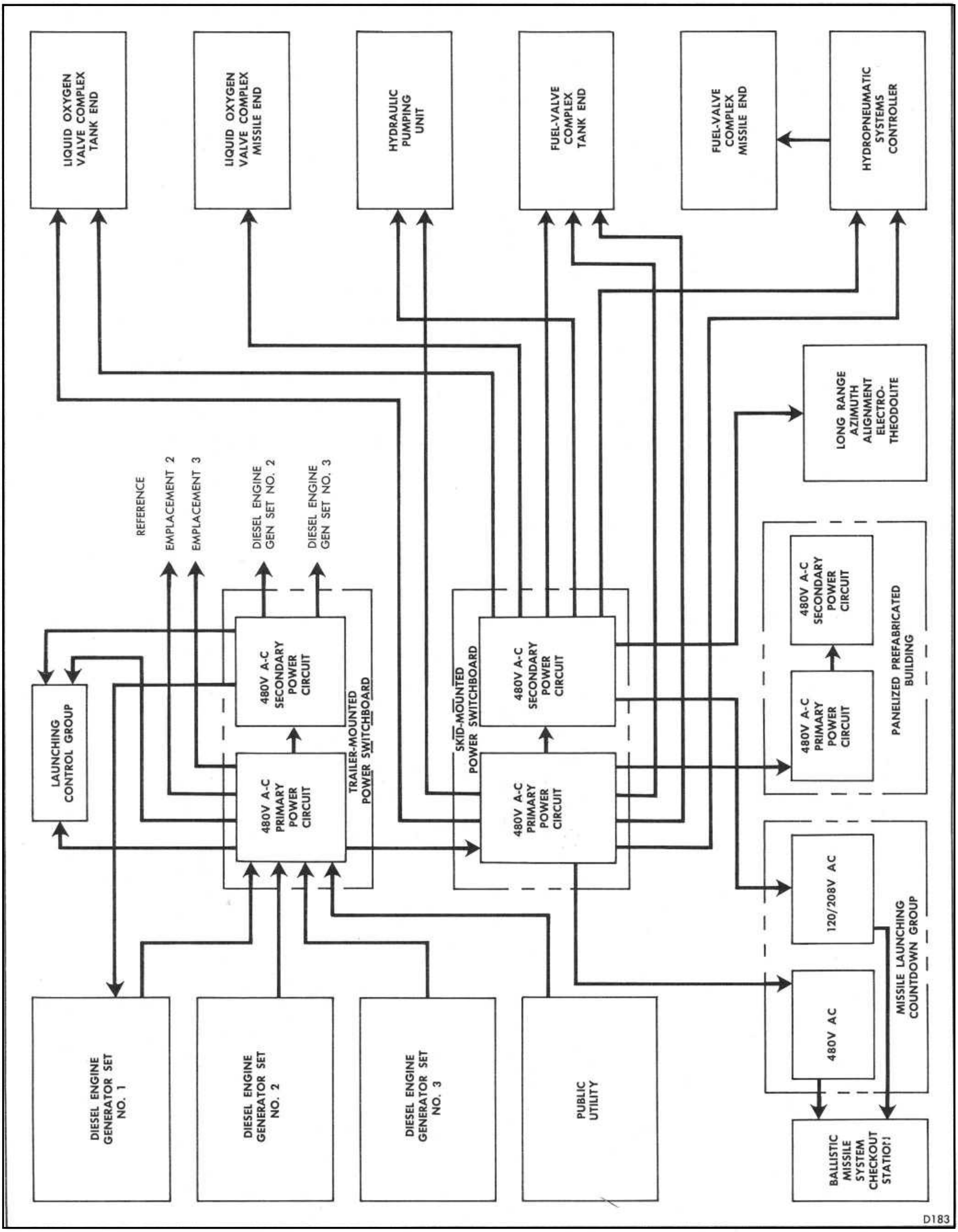


Figure 2-4. Launch Position Power Generation and Distribution System — Block Diagram

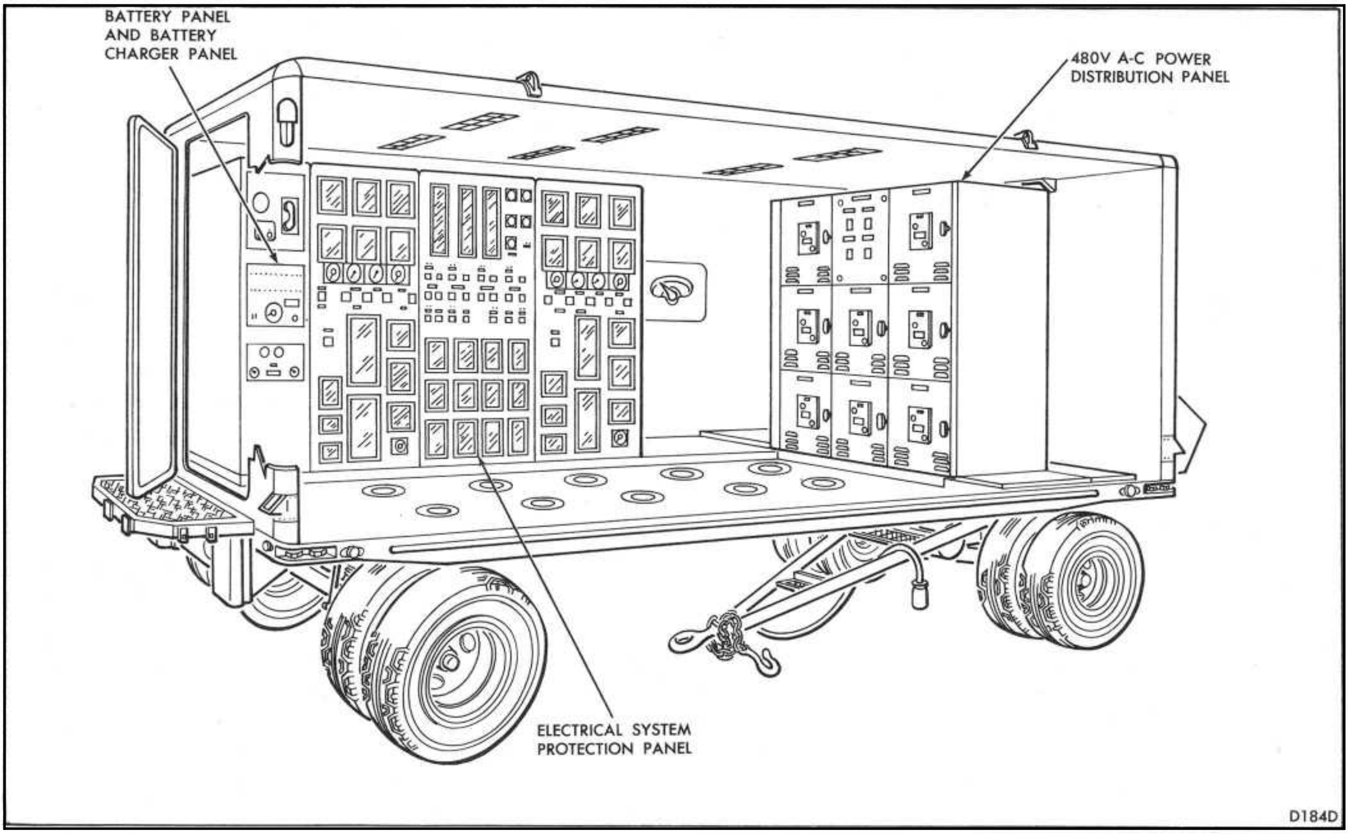


Figure 2-5. Interior View of Trailer-Mounted Power Switchboard (Sheet 1 of 2)

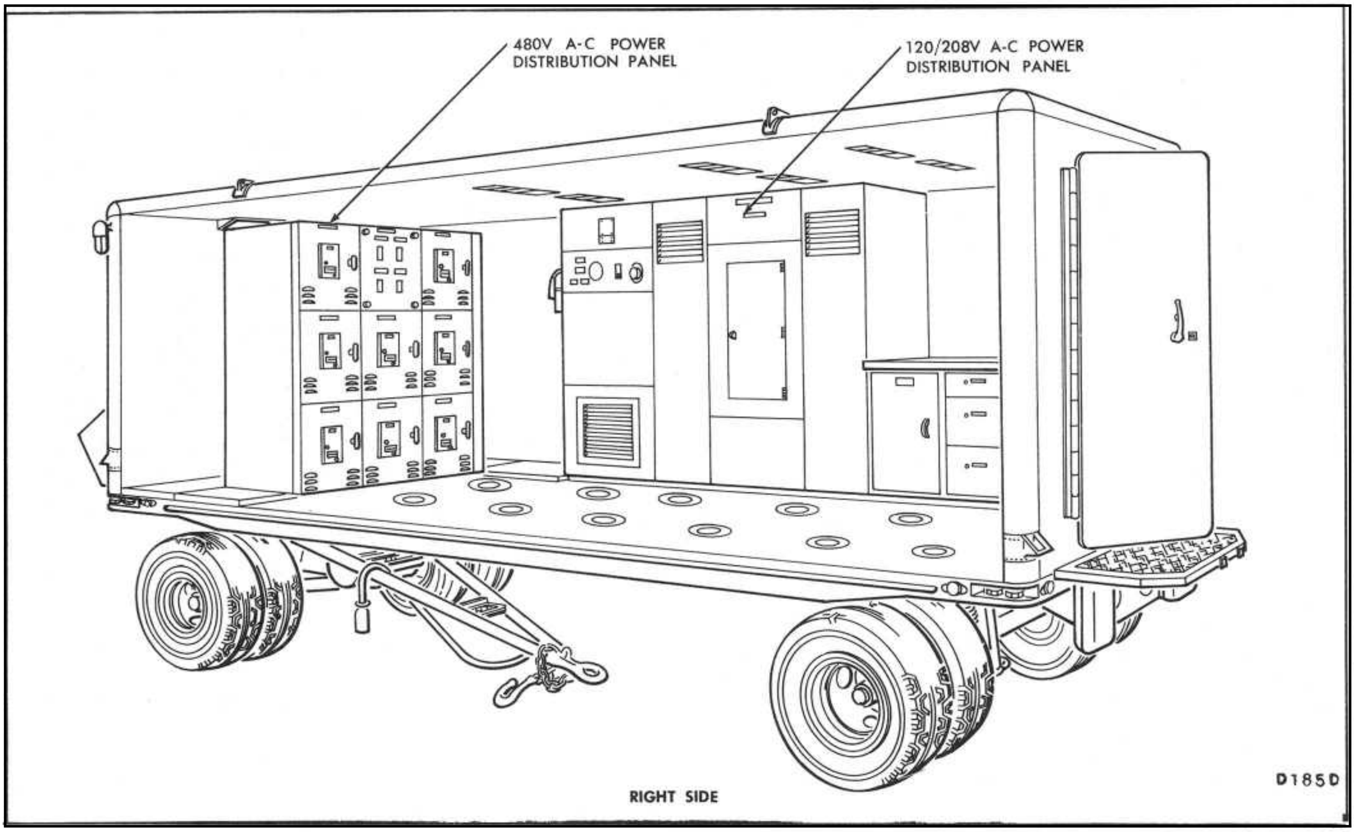


Figure 2-5. Interior View of Trailer-Mounted Power Switchboard (Sheet 2 of 2)

Table 2-1. Power Generation and Distribution System Equipment at the Launch Positions (Continued)

Equipment Name	*Index and Figure No.*	*Purpose*	*Characteristics*
480V a-c power distribution panel	7, 2-1 2-5	Distributes all primary 480V a-c power at launch position.	Eight triple-pole air circuit breakers, four triple-pole molded-case circuit breakers, floor-to-ceiling panel.
120/208V a-c power distribution panel	6, 2-1	Distributes power within trailer-mounted power switchboard to area lights, exterior convenience outlets, to 120/208V a-c power distribution panel in trailer-mounted launching control group, and diesel engine generator sets.	Rack-mounted circuit breaker panel containing one molded-case triple-pole main circuit breaker, one molded-case triple-pole subcircuit breaker, nine molded-case single-pole subcircuit breakers and transformers.
Skid-Mounted Power Switchboard JEU-1/E, or JEU-1A/E	15, 2-1 2-6	Receives and distributes all power required at missile launch emplacement.	Portable shelter, 112.5 kva 3-phase transformer, 480V a-c power distribution panel, 120/208V a-c power distribution panel.
112.5 kva 3-phase transformer	14, 2-1	Supplies all 120/208V a-c power required at missile launch emplacement.	Standing metal paneled enclosure.
480V a-c power distribution panel	16, 2-1	Serves as a 480V a-c power distribution center for missile launch emplacement.	Console mounted circuit breaker panel, one main triple-pole circuit breaker, 15 molded-case 3-pole circuit breakers, one molded-case single-pole circuit breaker.
120/208V a-c power distribution panel	17, 2-1	Serves as a 120/208V a-c power distribution center for missile launch emplacement.	Console mounted circuit breaker panel, 10 molded-case triple-pole circuit breakers, 12 molded-case single-pole circuit breakers.
Power switchboard console	1, 2-1	Distribute power within panelized building.	One triple-pole main circuit breaker, 3 kva single-phase transformer, three 10 kva single-phase transformers, power transfer switch, 480V a-c power distribution panel, 120/208V a-c power distribution panel and a 120V a-c power distribution panel.
120/208V a-c power distribution panel in the Trailer-Mounted Hydropneumatic Systems Controller AF/M46A-1	11, 2-1	Distributes trailer power within trailer.	Wall-mounted panel, four molded-case circuit breakers.
120/208V a-c power distribution panel in Trailer-Mounted Ballistic Missile System Checkout Station TTU-92/M	12, 2-1	Distributes power within trailer.	Rack-mounted circuit breaker panel, four single-pole circuit breakers, and four triple-pole circuit breakers.

Equipment Name	*Index and Figure No.*	*Purpose*	*Characteristics*
120/208V a-c power distribution panel in Trailer-Mounted Missile Launching Countdown Group A/M24A-1	13, 2-1	Distributes power within trailer.	Rack-mounted circuit breaker panel, 14 molded-case triple-pole circuit breakers, 18 molded-case single-pole circuit breakers and one molded-case triple-pole main circuit breaker.
120/208V a-c power distribution panel in Trailer-Mounted Missile Launching Equipment Simulator SMU-18/M or SMU-14/M		Distributes trailer power within trailer.	Rack-mounted circuit breaker panel, 10 molded-case triple-pole circuit breakers, and seven molded-case single-pole circuit breakers.

2-5. Prime power for RIM building requirements is usually obtained from the nearest public utility supply. If public supply is not available, diesel engine generator sets are utilized. Within the RIM building, motor-generator converters adapt the power to missile maintenance requirements. Separate conduit and outlet boxes are provided for distribution of d-c power and of 400-cycle and 60-cycle a-c power. The eight receptacles located in the communications terminal and equipment room are supplied by separate lines and circuit breakers which are provided with an alternate power source of 40 kva in case of a general power failure. The gyro-heater system has separate primary and emergency power constantly available. This is accomplished with a 10 kilowatt-ampere 400-cycle motor-generator converter and a 400-cycle 10 kilowatt-ampere gasoline driven generator. These two units are tied into the gyro-heater circuit by automatic switching. If prime power fails, the gasoline engine-driven generator will start automatically and supply the required power within 60 seconds. Power outlet receptacles, located in each working area, make available the types of power listed in table 2-2.

Table 2-2. Power in the RIM Building

Item	*Voltage*	*Type*	*Frequency in Cycles per Second*	*Available Power*
1	440 ac	3-phase	60	272.60 kva
2	120/208 ac	3-phase	60	176.50 kva
3	115/199 ac	3-phase	400	7.25 kva
4	115/199 ac	3-phase	400	9.14 kva
5	120 ac	1-phase	60	56.76 kva
6	115 ac	1-phase	400	3.10 kva
7	28 dc			8.23 kw

2-6. Prime power at each launch position is provided by three trailer-mounted diesel engine generator sets. An alternate source of power is local utility electricity. Power from either source is distributed by the trailer-mounted power switchboard in the launching control area to three skid-mounted power switchboards, one at each emplacement. Gyro-heater emergency power is supplied automatically by a battery-driven alternator in the launching control group. Battery life, under load, is approximately 2 hours.

2-7. OPERATION.

2-8. The RIM building power distribution system consists of a network of conductor cables which distribute power to convenience outlets, motors, and heaters in the various rooms of the building. The power is prepared for use by converters which change the frequency, transformers which change the current and voltage relationship, regulators which maintain consistent power output, rectifiers which convert a-c voltage to d-c voltage, and circuit breakers which protect circuits and applied equipment throughout the building.

2-9. The launch position power generation and distribution system (figure 2-4) is maintained in a state of operational readiness. It can be put into operation automatically by the GEN START switch on the launch officer control console in the trailer-mounted launching control group. Power generation originates with the reciprocating engine in the diesel engine generator sets. This mechanical power drives the generators which in turn produce electrical power for the weapon system. Engine generator control consoles house equipment required to control these prime

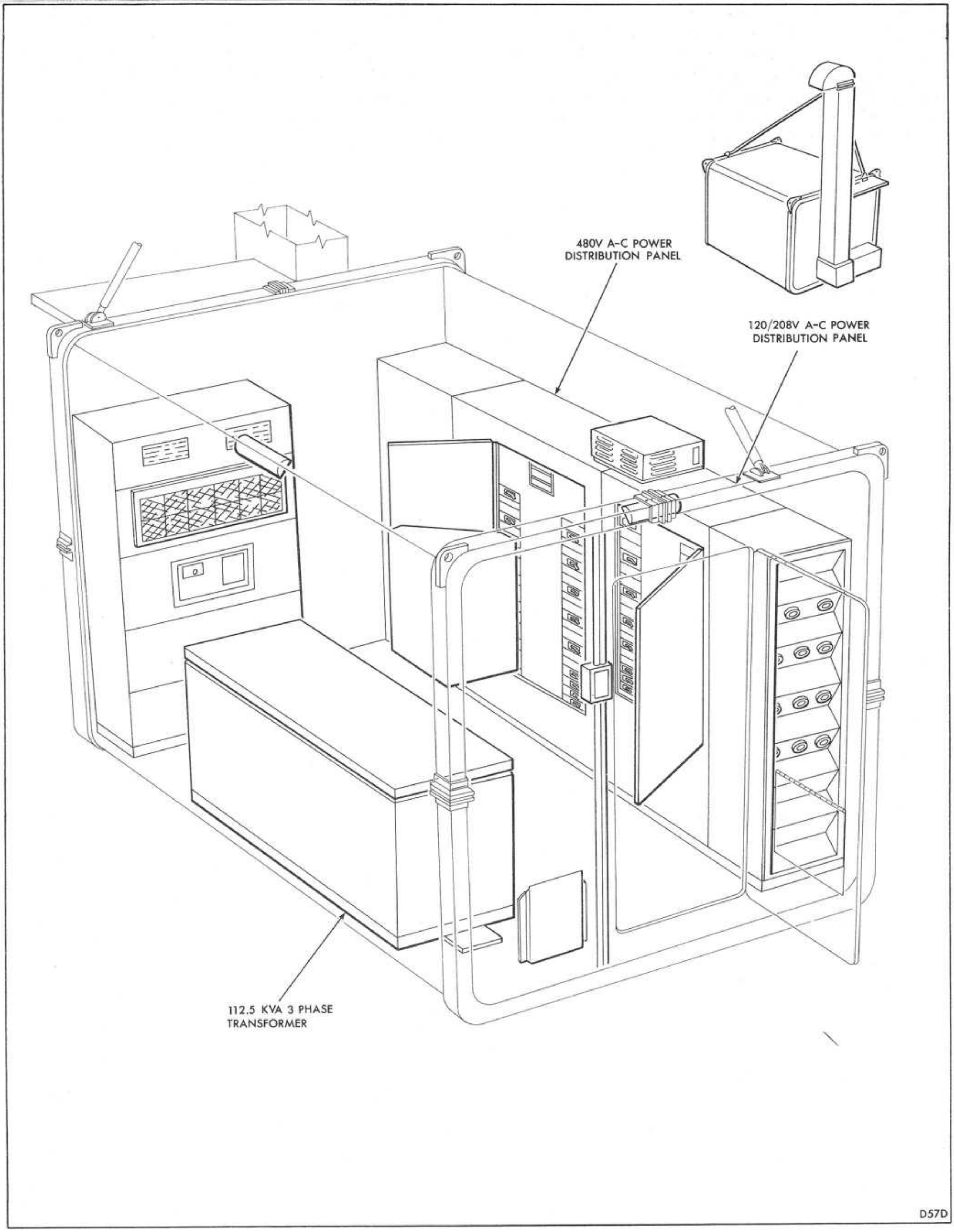


Figure 2-6. Skid-Mounted Power Switchboard

movers. The trailer-mounted power switchboard (figure 2-5) receives all power for distribution at the launch position. Through a network of underground cables, transformers, and distribution panels, 480V a-c, three-phase power is supplied to weapon system equipment such as motors and heaters. Systems requiring 120/208V a-c power are supplied through the use of transformers. Power malfunctions are isolated by distribution panels and localized by circuit breakers. There is a skid-mounted power switchboard (figure 2-6) at each launch emplacement. It receives all power for the area and distributes primary and secondary power to trailers, shelters, and weatherproof equipment.

SECTION III

COMMUNICATIONS SYSTEM

3-1. PURPOSE.

3-2. The communications system provides telephone and public address facilities for squadron operation (figure 3-1) and maintenance. It is self-sufficient, operating independently of commercial or other communications facilities.

3-3. The communications system is functionally divided into four separately operating, but related networks. They are the command, logistics, maintenance, checkout, and alert sound networks. The command, logistics, and maintenance checkout networks are telephone circuits. The alert sound network is a public address system controlled by the telephone circuits.

3-4. DESCRIPTION.

3-5. Communications equipment consists of four complete equipment cabinets containing amplifiers, relay units, and main and emergency power supplies. These equipment cabinets are located as follows: Two in the RIM building, one in the SI building, and one in the launch control group. Switchboards, loudspeakers, telephones, and cables are provided to complete the system.

3-6. OPERATION.

(See figure 3-2.)

3-7. The operational functions of the networks are as follows:

a. The command network provides a means of maintaining communications with all squadron activities.

b. The logistics network provides communications between the maintenance duty officer and the armament staff officer, or between either of these officers and any of the launch control officers.

c. The maintenance checkout network provides communications for personnel engaged in missile or equipment maintenance operations. A supplementary network is provided for each missile in the RIM building or on a launching emplacement.

d. The alert sound network provides the squadron with public address facilities.

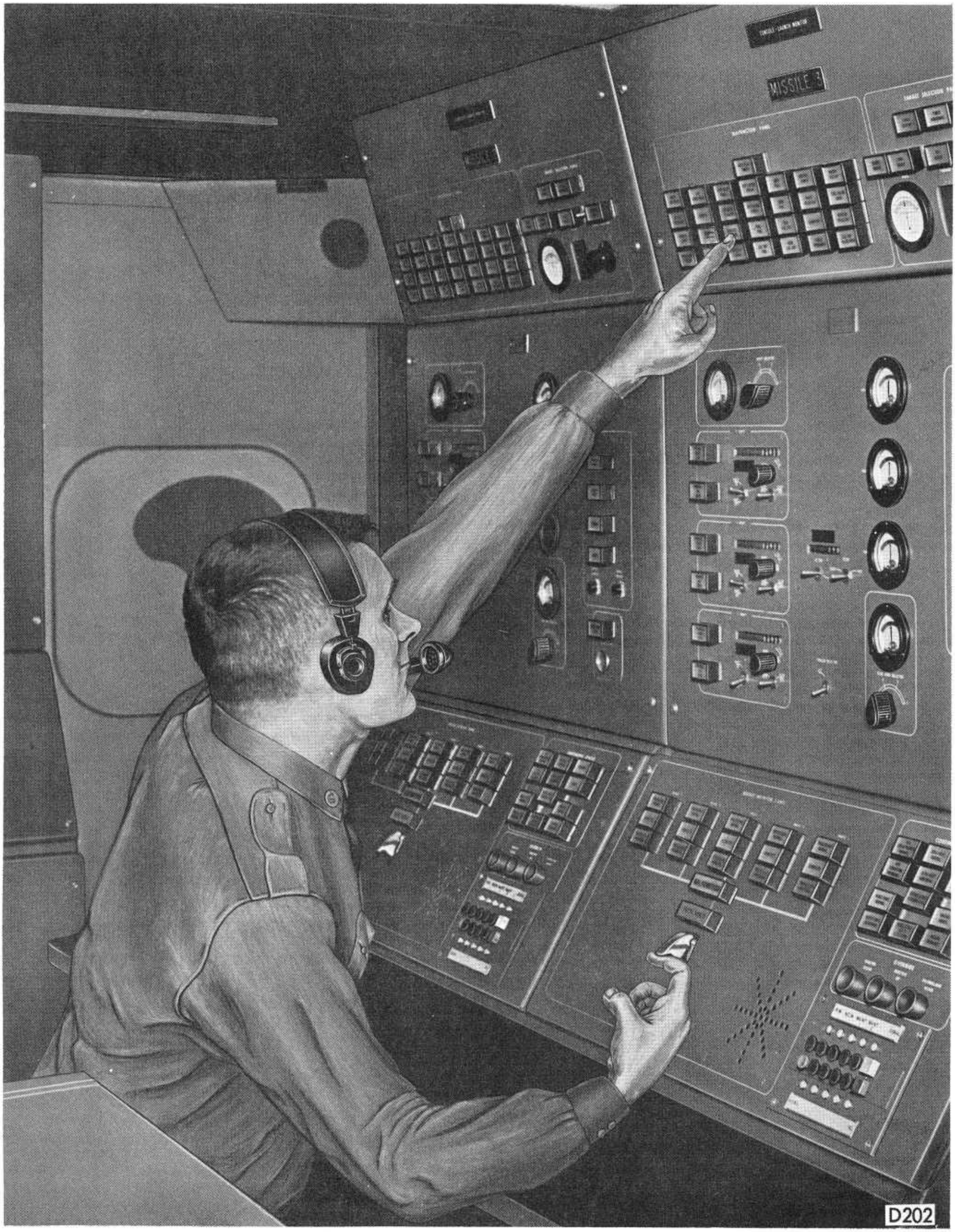


Figure 3-1. Communications—Launch Monitor Console

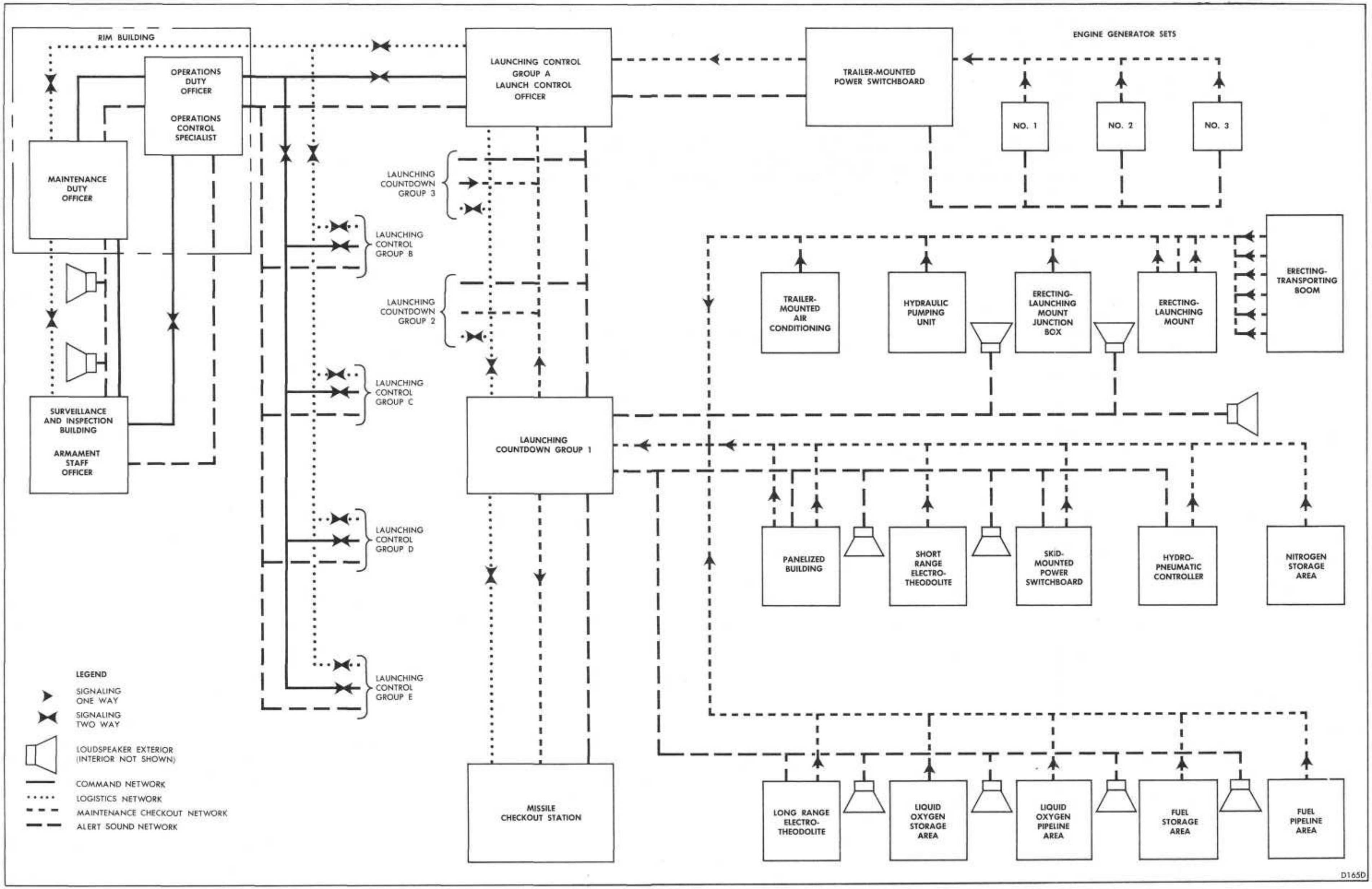


Figure 3-2. Communication System — Data Flow Diagram

SECTION IV

MISSILE AIRFRAME

4-1. PURPOSE.

4-2. The missile airframe, in conjunction with the re-entry vehicle, provides the SM-75 missile with an aerodynamic profile. It also houses, supports, and protects the missile airborne systems.

4-3. DESCRIPTION.

4-4. The missile airframe (figures 4-1 and 4-2) is 63 feet long and has a maximum diameter of 8 feet. It is composed of five basic sections: the guidance section, fuel tank section, center body section, liquid oxygen tank section, and engine and accessories section. The 8-foot diameter of the airframe is the same throughout the engine and accessories section, liquid oxygen tank section, and center body section. Forward of the center body section the airframe tapers from a diameter of 8 feet at the aft end of the fuel tank section to 5¼ feet at the forward end of the guidance section.

4-5. Two exterior tunnels (figure 4-3), one on each side of the missile, are formed by curved sections of fiberglas that extend from the guidance section to the engine and accessories section. Each tunnel is 41 feet long, 10 inches wide, and 2 inches high. These tunnels protect pneumatic plumbing and electrical cables running along the exterior of the missile.

4-6. GUIDANCE SECTION.
(See figure 4-4.)

4-7. The guidance section, located at the forward end of the missile airframe, contains the guidance and flight control equipment. It is 9 feet long and tapers from a 6¼-foot diameter to a 5¼-foot diameter. This section is constructed of aluminum alloy skin, frames, and stringers. The guidance and flight control equipment is made available through access doors. These doors facilitate guidance and flight control inspection, servicing, removal, and replacement. Air-conditioning inlet doors and electrical umbilical receptacles provide entrance for air-conditioning ducts and ground umbilical cable plugs.

4-8. The aft end of the guidance section is attached to the forward end of the fuel tank section. Three re-entry vehicle latch access doors are spaced 120 degrees apart around the forward end of the guidance section. They afford access to the re-entry vehicle latches which fasten the re-entry vehicle to the guidance section. The exterior surface of the guidance section forms an integral part of the aerodynamic profile of the missile.

4-9. FUEL TANK SECTION.
(See figure 4-5.)

4-10. The fuel tank section continues the profile of the missile airframe from the aft end of the guidance section to the center body section. It forms a fuel tank with a capacity of 4812 gallons. The fuel tank section is 15½ feet long and tapers from a diameter of 8 feet to 6¼ feet. It is formed from three sheets of ¼-inch aluminum alloy milled in a waffle pattern to obtain a high strength-to-weight ratio. These sheets are joined by internal and external longitudinal welds, while intermediate frames (8) provide additional rigidity and strength. The fuel tank section is closed by dome-shaped forward and aft bulkheads (5 and 2). Anti-vortex filters (7) are attached inside the aft bulkhead (2) at the transition cone (6) to prevent fuel from swirling and to filter the fuel as it leaves the fuel tank section.

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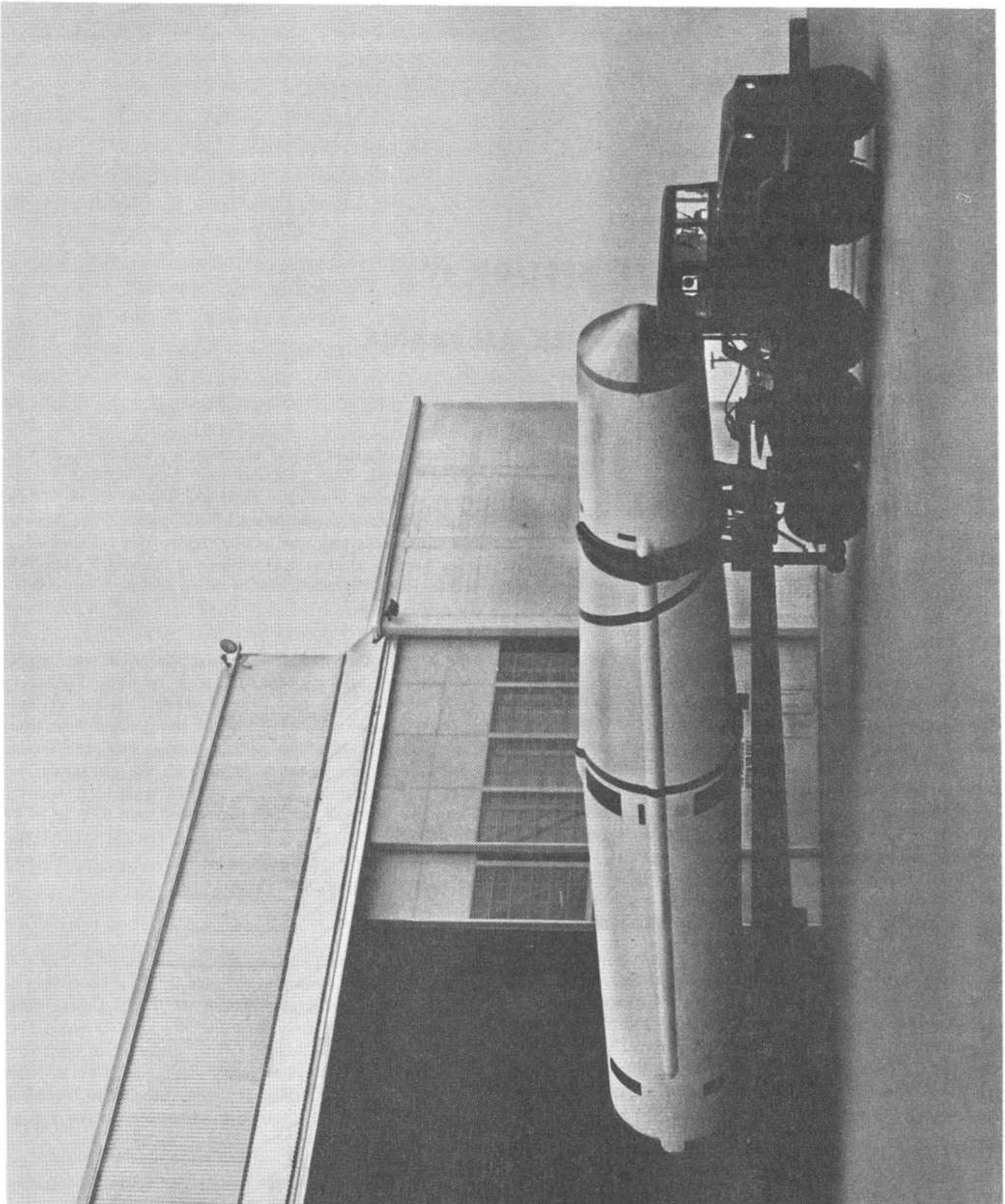


Figure 4-1. Missile Airframe

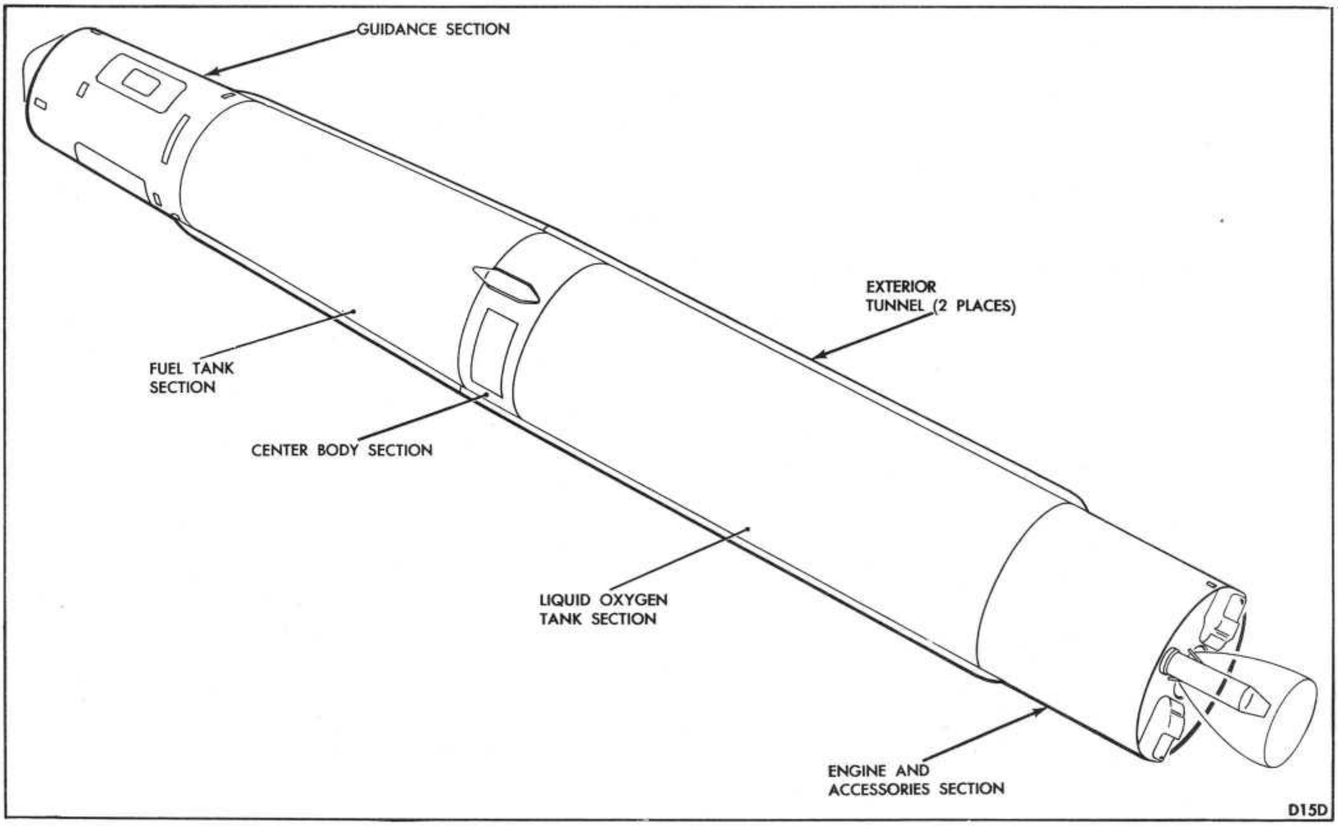


Figure 4-2. Missile Airframe Structure

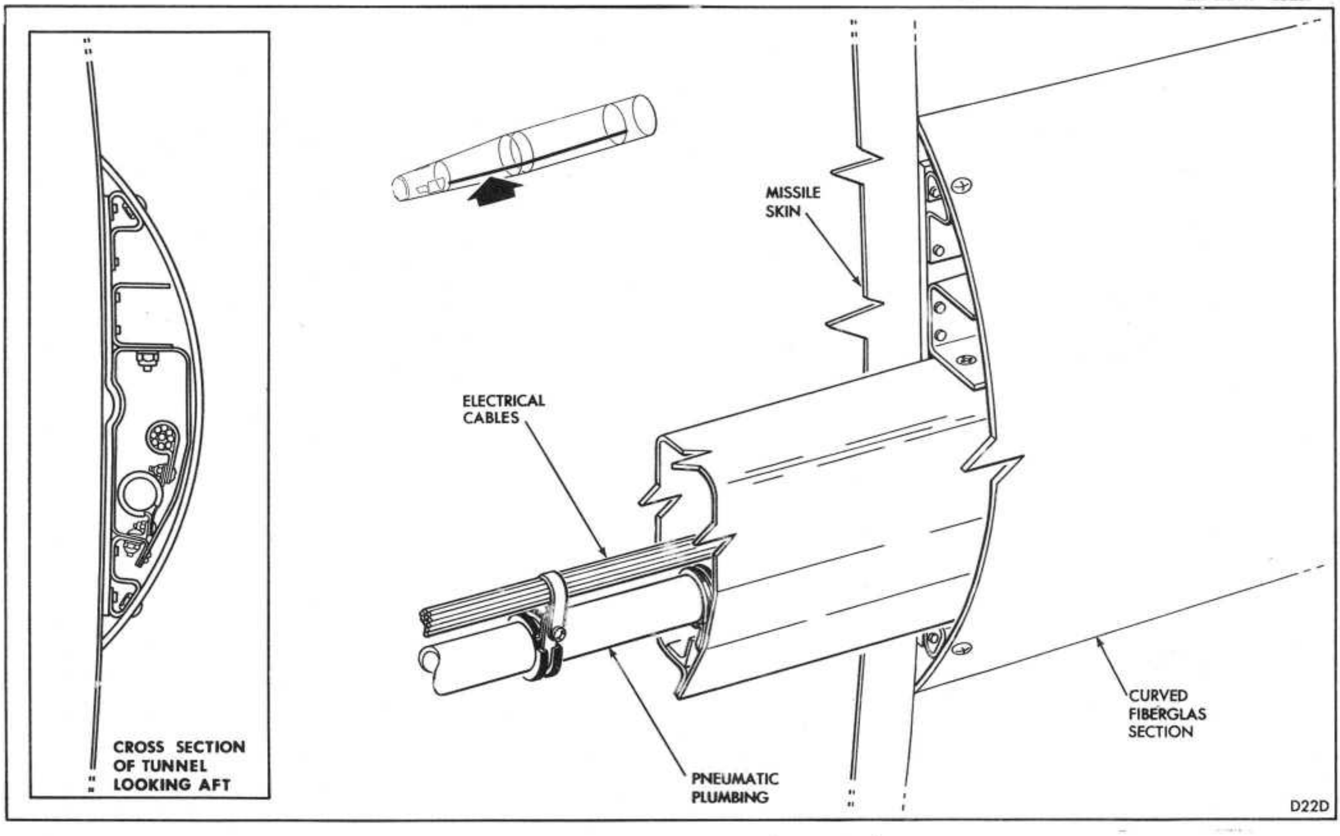


Figure 4-3. Exterior Tunnel (Typical)

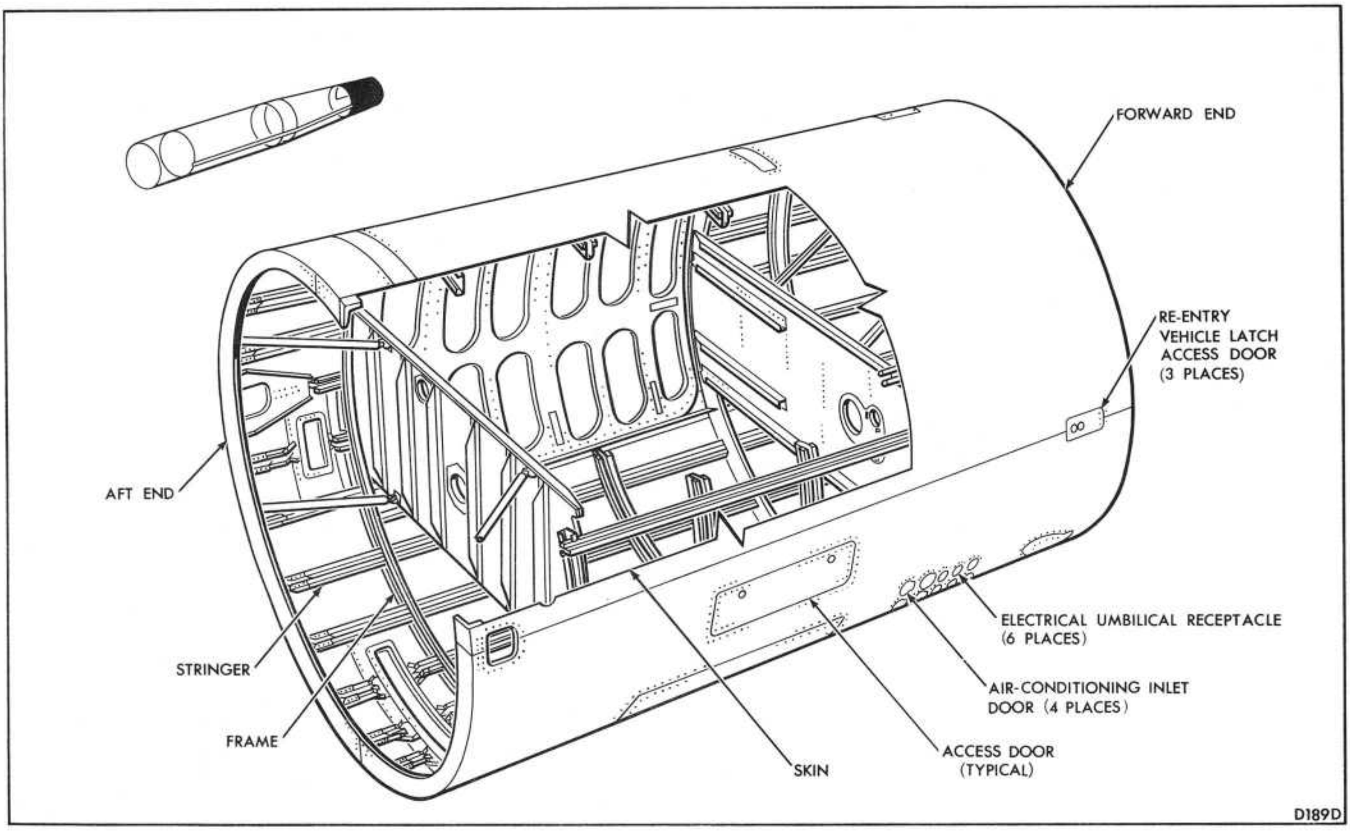


Figure 4-4. Guidance Section

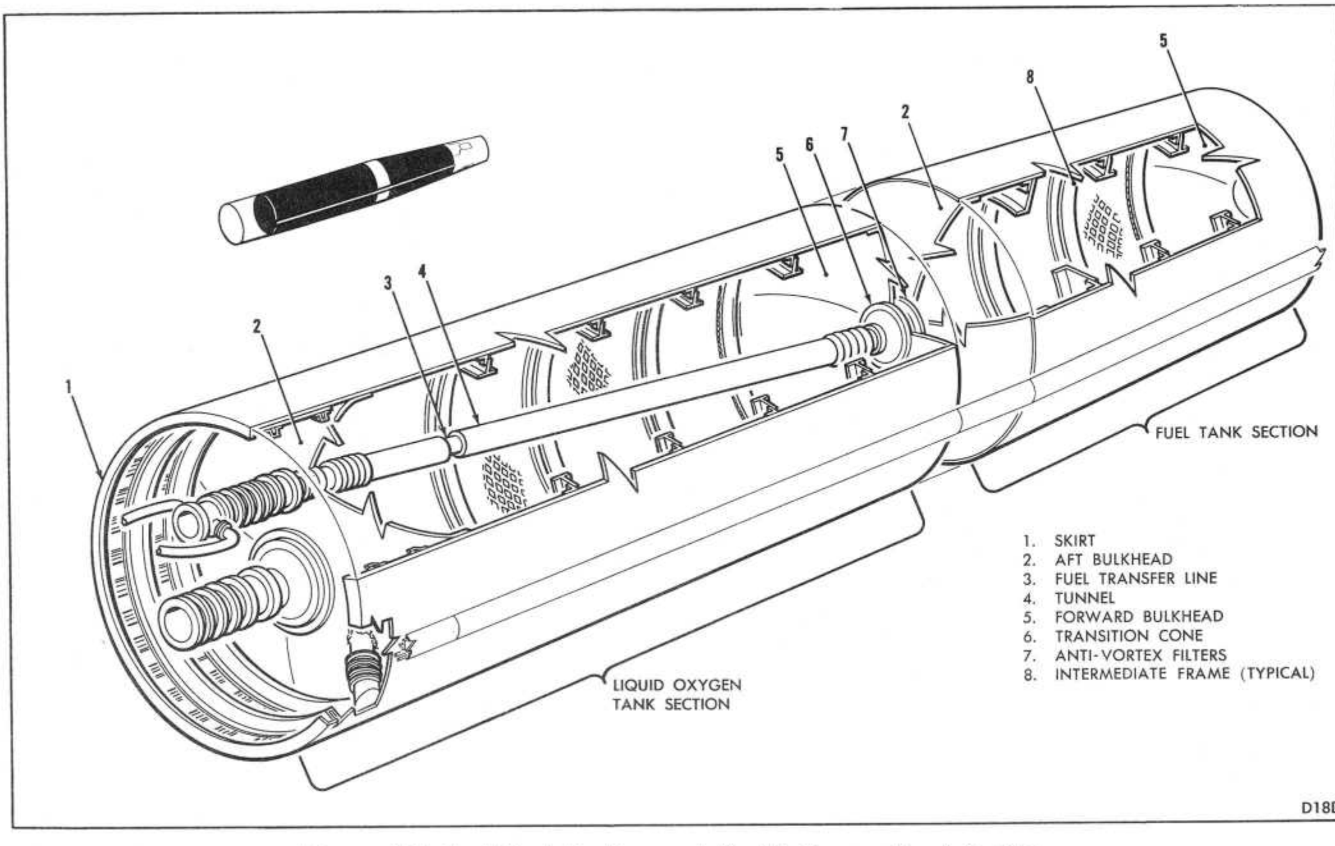


Figure 4-5. Fuel Tank Section and Liquid Oxygen Tank Section

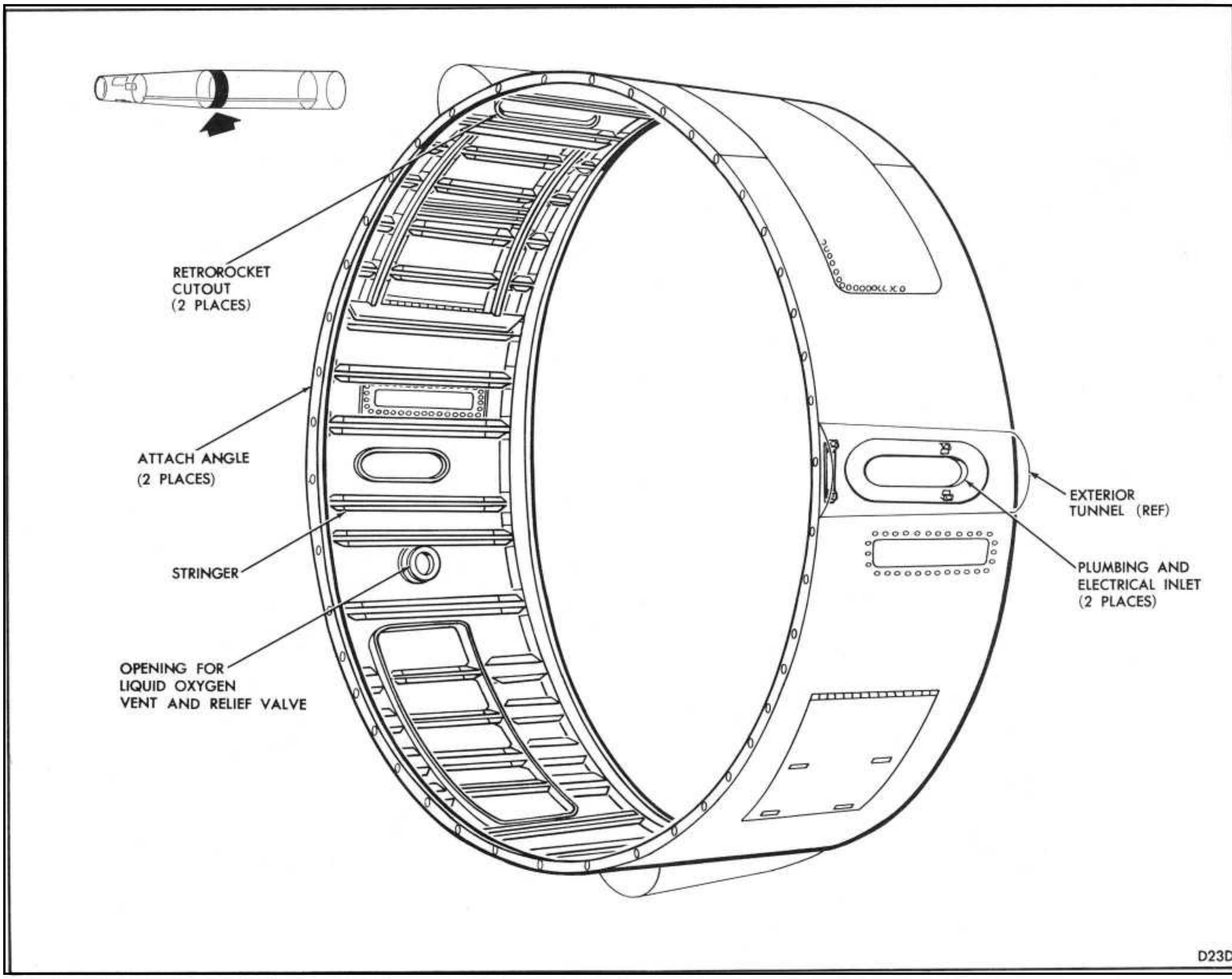


Figure 4-6. Center Body Section

4-11. CENTER BODY SECTION.
(See figure 4-6.)

4-12. The center body section is the beginning of the constant-diameter portion of the missile airframe. It houses the rate gyro distribution box, rate gyros, retrorockets, and a vent and relief valve for the liquid oxygen tank. The center body section structurally unites the liquid oxygen tank and fuel tank sections. It is a cylindrically shaped section, approximately 3 feet long and 8 feet in diameter, constructed of aluminum alloy skin, stringers, and attach angles. Access doors are provided for inspection, servicing, removal, and replacement of the equipment inside the section. Exterior tunnels protect the inlets for plumbing and electrical accessories.

4-13. LIQUID OXYGEN TANK SECTION.
(See figure 4-5.)

4-14. The liquid oxygen tank section is a continuation of the constant-diameter portion of the missile airframe. It forms a liquid oxygen tank with a capacity of 7420 gallons. The structure of the liquid oxygen tank section is similar to that of the fuel tank section, except that it is not tapered. This tank is 22 feet long and 8 feet in diameter. The liquid oxygen tank section contains a tunnel (4) through which an insulated fuel transfer line (3) is routed from the fuel tank section to the engine and accessories section. A skirt (1), containing liquid oxygen fill provisions, is located at the aft end of the liquid oxygen tank section and structurally joins the fuel transfer line (3) to the engine and accessories section.

4-15. ENGINE AND ACCESSORIES SECTION.
(See figure 4-7.)

4-16. The engine and accessories section is the aft segment of the constant-diameter portion of the missile

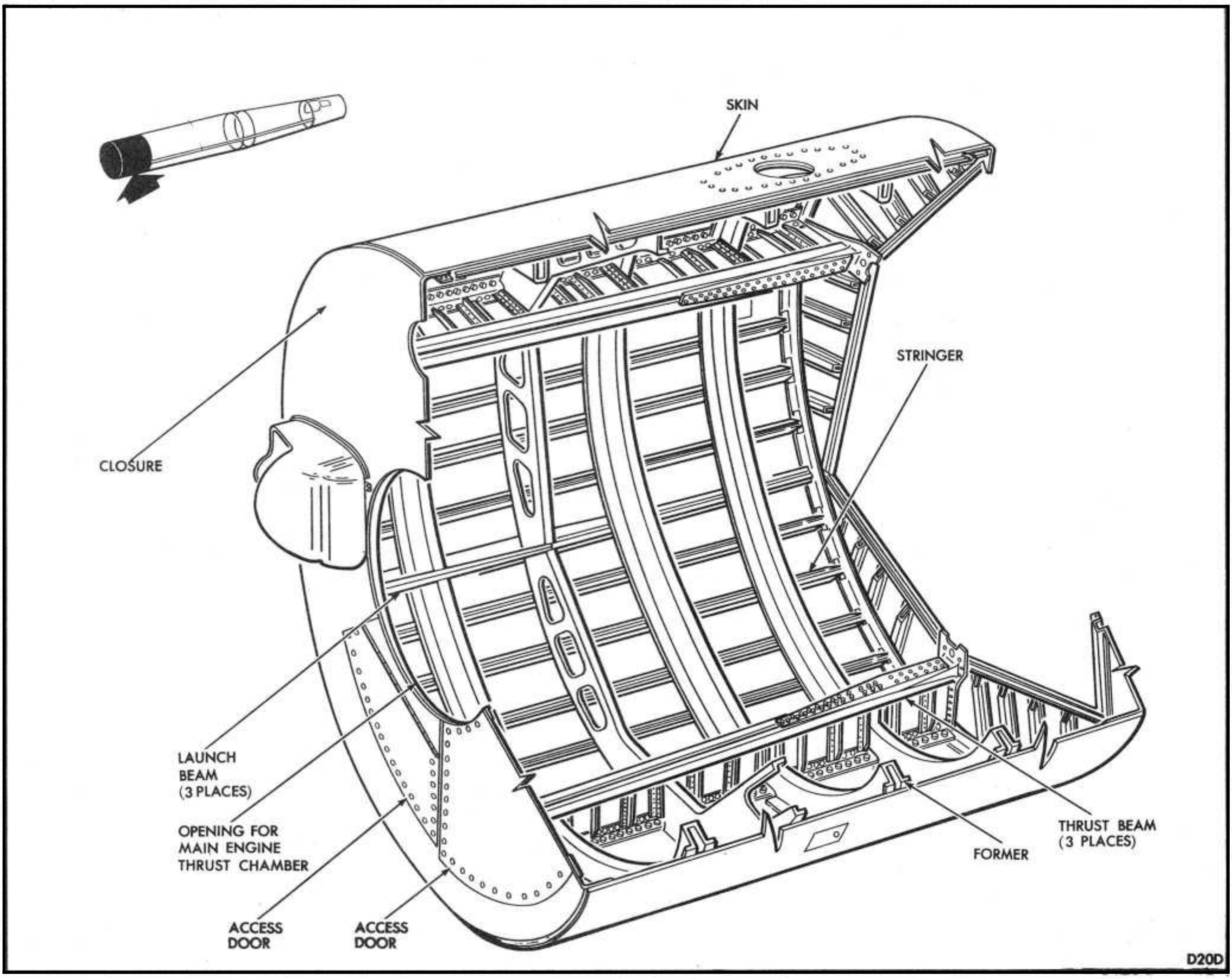


Figure 4-7. Engine and Accessories Section

airframe. This section supports the vernier engines and houses the main engine, the hydraulic power pack, and the fuel fill provisions. This section is cylindrical in shape, 7 feet long, and 8 feet in diameter. The engine and accessories section is constructed of aluminum alloy skin, stringers, beams, and formers. Three thrust beams, extending the full length of the section, transmit thrust loads from the three-point main engine mount to the missile airframe. The weight of the missile on the erecting-launching mount is distributed through these thrust beams as well as through three launch beams. Access doors in the aft closure provide entrance to the interior of the engine and accessories section for inspection and maintenance activities. The closure at the aft end of the engine and accessories section provides a support for the two externally mounted vernier engines and contains an opening for the main engine thrust chamber.

4-17. REPAIR.

4-18. The repairs that can be made to the missile airframe at the squadron level are limited. The missile is returned to the manufacturer for major repair of the fuel tank section and liquid oxygen tank section or any repair that requires that the guidance, fuel tank, center body, or liquid oxygen tank sections be separated from the rest of the missile airframe. Minor repairs, such as those of cracks and dents in stringers or formers, are usually made at the RIM building. The replacement of damaged inspection panels in the aft closure of the engine and accessories section can be made at either the RIM building or the launch emplacement. If damage to the engine and accessories section cannot be repaired at the RIM building, the entire section is replaced. Minor replacements, such as tunnels or access doors, can be accomplished in the RIM building or at the launch emplacement.

9
GUID 15 1/2
FUEL 3
CENT - 22
LOX - 7
ENG -
56

SECTION V

ERECTING-LAUNCHING MOUNT SYSTEM

5-1. PURPOSE.

5-2. The erecting-launching mount system raises the missile to launching position and also provides a support base from which the missile is fired.

5-3. DESCRIPTION.

5-4. The erecting-launching mount system (figure 5-1) consists of the equipment described in table 5-1.

Table 5-1. Erecting-Launching Mount System Equipment

Equipment Name	*Index and Figure No.*	*Purpose*	*Characteristics*
Hydraulic Pumping unit AF/M42A-1 or AF/M42A-1A	5-1 5-2		Trailer-mounted, steel frame, single-piece roof; top-hinged side panels; and steerable undercarriage.
Hydraulic power unit	2, 5-2	Deliver up to 3000 psi of hydraulic pressure.	60-gallon reservoir; 480V a-c 3-phase, 60-cycle electric motor; motor-driven hydraulic pump; fixed-displacement hydraulic pump; associated pressure and return hoses and valves.
Circuit breaker panel	1, 5-2	Rectify, control, and distribute electrical power.	Rectifier unit, six manual reset circuit breakers, and thermal overload reset button.
Local control panel	3, 5-2	Control and distribute electrical power.	Eleven switch-type circuit breakers, eight local control pushbutton switches, and associated indicator lights.
Jog and emergency control switch	4, 5-2	Aid in initial adjustment of erecting-launching mount. Bypasses interlock circuits.	Portable junction box, extension cable, pump motor switch, and two pushbutton controls.
Ballistic Missiles Erecting Transporting Boom GSU-33/E	5-1 5-3	Act as erecting arm to raise missile; used in conjunction with rear trailer dolly to transport missile.	63-foot and 10-foot steel frame; four interchangeable, manually operated landing gears; communication and electrical systems.

(Continued on Page 5-4)

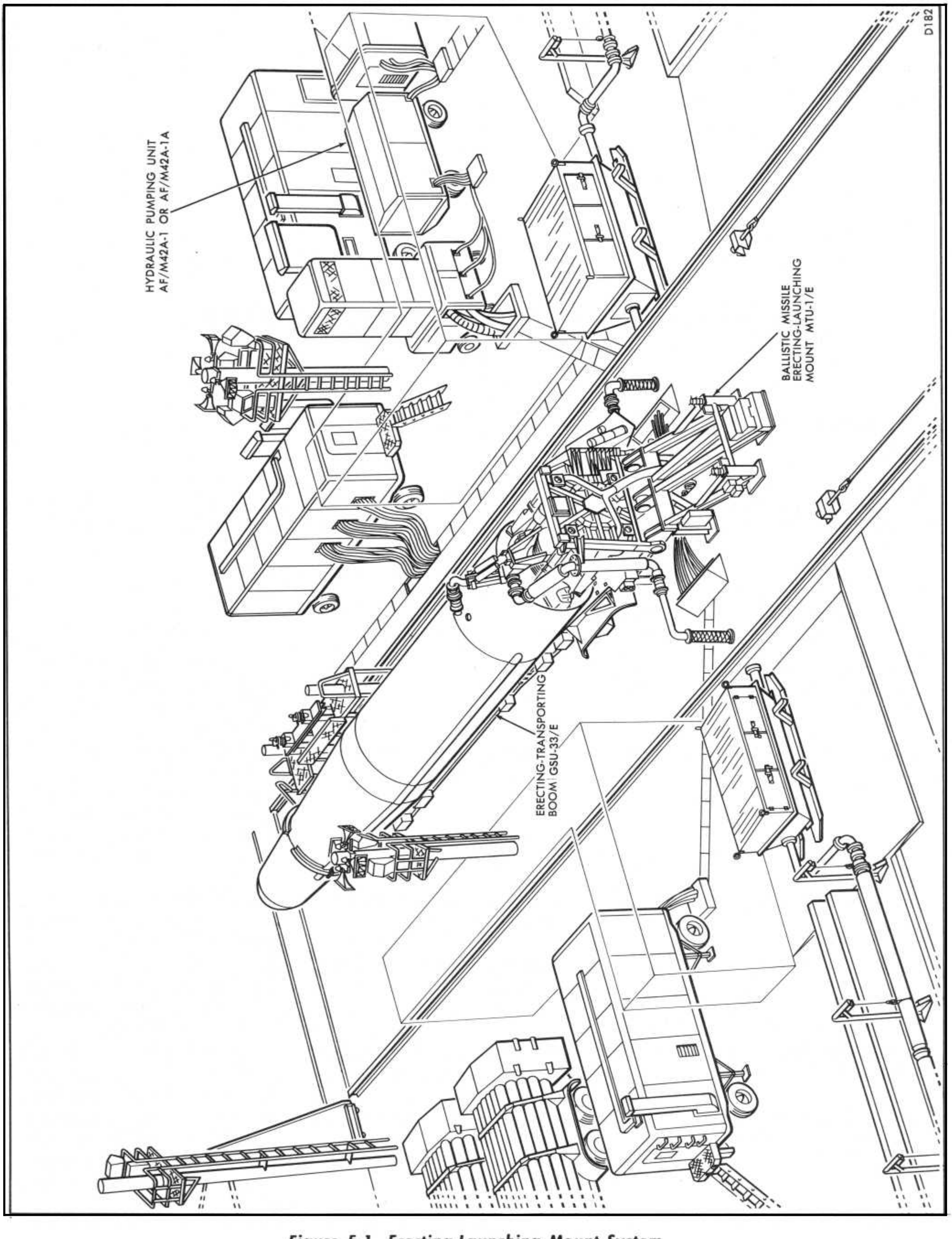


Figure 5-1. Erecting-Launching Mount System

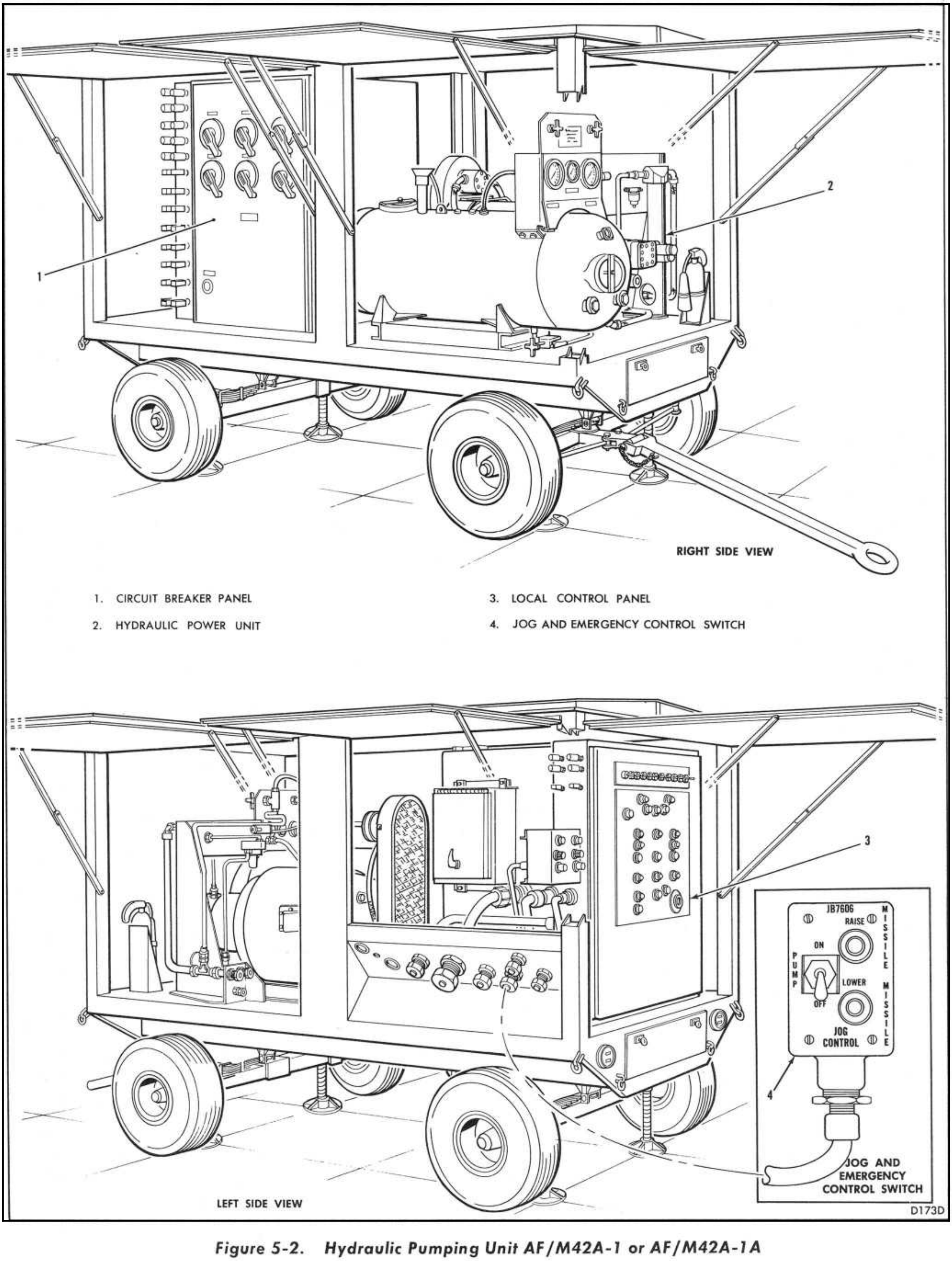


Figure 5-2. Hydraulic Pumping Unit AF/M42A-1 or AF/M42A-1A

Table 5-1. Erecting-Launching Mount System Equipment (Continued)

Equipment Name	*Index and Figure No.*	*Purpose*	*Characteristics*
Forward cradle and clamshell arms	5-3	Support and retain missile in all positions.	Padded lower cradle; two hydraulically operated, hinged clamshell arms; clamshell hydraulic cylinder and linkage; four safety limit switches; warning horn; and short-range theodolite door closer.
Aft cradle	5-3	Support and align missile during mating.	Padded support assembly; two hydraulically operated jack assemblies.
Hydraulic supply unit	5-3	Furnish hydraulic pressure to operate clamshell arms and adjust aft cradle.	Six-quart hydraulic reservoir, three hand pumps, three pressure gages, associated controls and valves.
Ballistic Missile Erecting-Launching Mount MTU-1/E	5-1 5-3	Erect and support missile and serve as launching platform.	Steel platform with mounting legs, acts as base for 60-foot umbilical mast.
Upper base	7, 5-4	Serves as platform for erecting missile and associated equipment.	Steel hinged unit containing six pylons and launching legs, fuel mast, umbilical mast platform, umbilical mast, liquid oxygen mast, and accessories.
Launching legs and Pylons	3, 5-4	Support missile in erected horizontal positions.	Hinged, mechanically retractable steel legs; six launch pins (three smooth and three threaded); three launch pin motor actuators to retract threaded pins; and safety devices.
Fuel mast	4, 5-4	Provide for missile fueling.	Mechanically retractable steel support assembly, fuel line, bearing brackets, latching mechanism, joints and connectors, nozzle, and fuel sensor.
Liquid oxygen mast	2, 5-4	Load missile with liquid oxygen.	Mechanically retractable support assembly, bearing brackets, spring-loaded actuators, liquid oxygen line, swivel joints and connectors.
Umbilical mast and platform	1, 5-4	Support forward electrical cables and air-conditioning ducts.	Sixty-foot retractable steel and aluminum structure, umbilical lines, plug carrier, hydraulic accumulator and pressure gage, control valve, hydraulic cylinder and associated linkage, valves, and lines, handcrank, and electrical connections.

(Continued on Page 5-9)

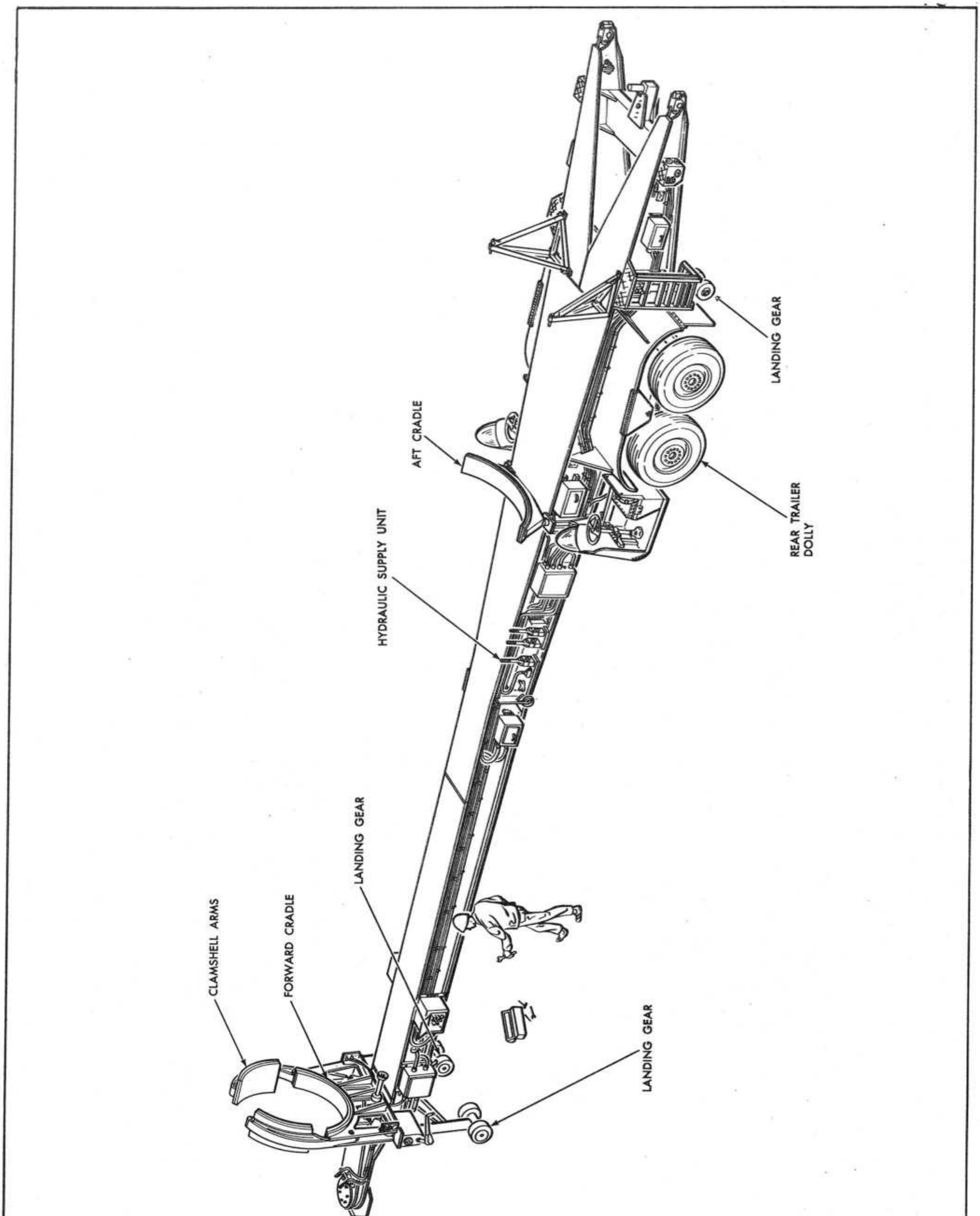


Figure 5-3. Erecting-Transporting Boom and Rear Dolly

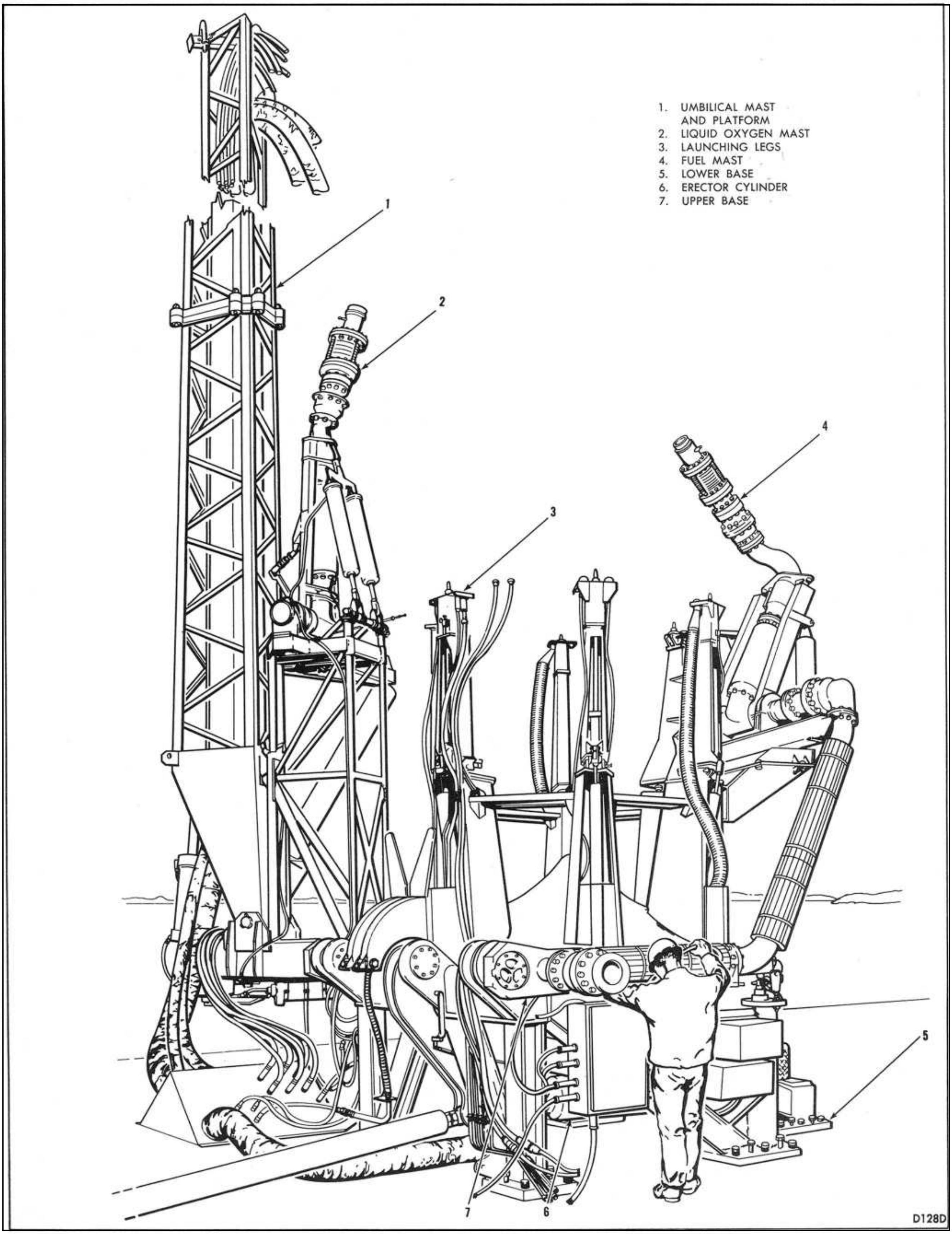


Figure 5-4. Ballistic Missile Erecting-Launching Mount MTU-1/E

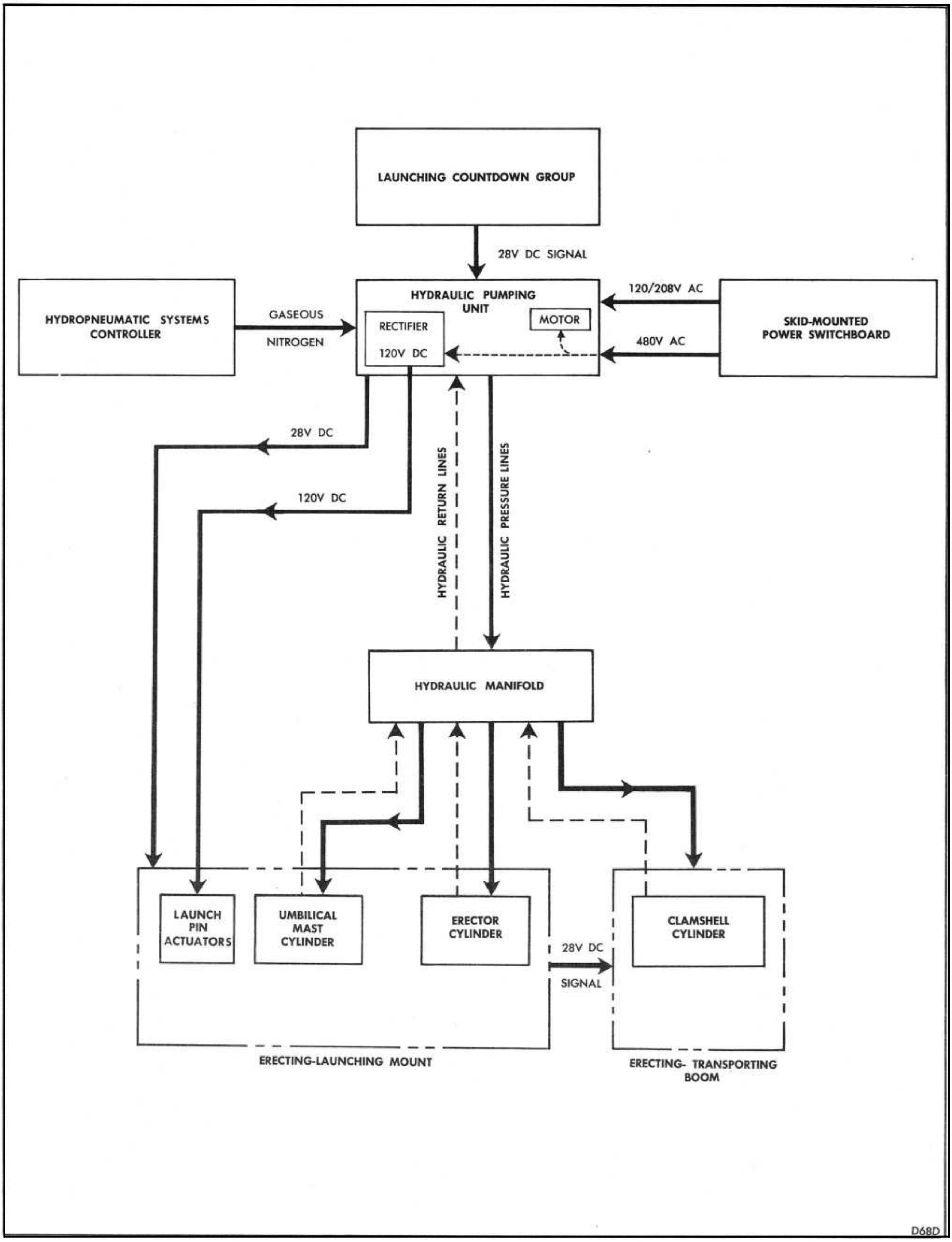


Figure 5-5. Erecting-Launching Mount System — Data Flow Diagram

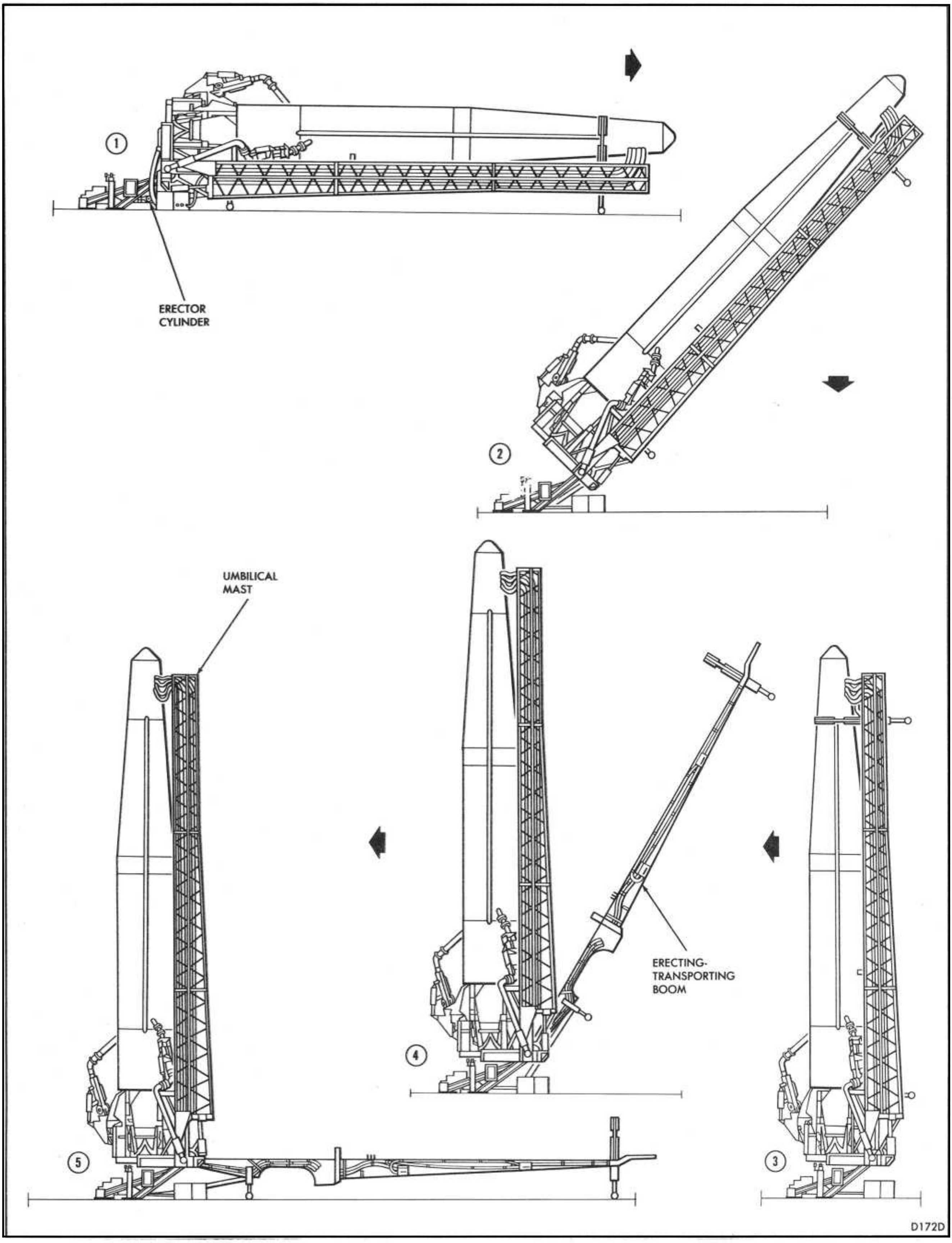


Figure 5-6. Erecting-Launching Mount Operation

Table 5-1. Erecting-Launching Mount System Equipment (Continued)

Equipment Name	*Index and Figure No.*	*Purpose*	*Characteristics*
Lower base	5, 5-4	Support upper base and its associated equipment.	Rigid steel framework, hydraulic manifold, hydraulic lines, junction box and electrical connections, trunnions and bearing assemblies, hydraulic erector cylinder with valves, linkage, and lines.

5-5. OPERATION.
(See figure 5-5.)

5-6. Operation of the electrically controlled components of the erecting-launching mount system is dependent upon outside sources of power. This power is received, controlled, and distributed through the hydraulic pumping unit. Power lines from the skid-mounted power switchboard E, provide 480V a-c power and 10/208V a-c power to the pumping unit. The hydraulic pump motor is operated by 480V a-c power. Power is also supplied to a rectifier circuit in the circuit breaker panel which converts it into 120V d-c power for operating the launch pin motor actuators. A line supplying 28V d-c power comes from the missile launching countdown group. This power energizes the control circuitry through the local control panel of the hydraulic pumping unit.

5-7. The hydraulic reservoir of the pumping unit receives a constant purge pressure of 2 psi of gaseous nitrogen from the hydropneumatic systems controller.

5-8. ERECTOR RAISE SEQUENCE.
(See figure 5-6.)

5-9. With the start of phase II the following functions occur: complete retraction of the panelized building, simultaneous slewing of missile engines and starting of the hydraulic pumping unit. When the panelized building reaches the 93-foot position, two signal switches are tripped, starting missile erection. The hydraulic pumping unit has already raised hydraulic pressure to the 3000 psi required for missile erection. Hydraulic pressure is then supplied to the hydraulic manifold of the erecting-launching mount. At 2500 psi, a selector valve motor operates a selector valve which admits hydraulic pressure to the erector cylinder (6, figure 5-4) and erects the missile (1 and 2, figure 5-6). After the erection cycle, the umbilical mast hydraulic accumulator is pressurized to aid in the retraction of the mast at lift-off. When the missile is vertical (3, figure 5-6), the upper base locks to the lower base and launch mount hydraulic pressure is removed. The erector up and locked signal initiates phase III start signal.

5-10. ERECTOR LOWER SEQUENCE.

5-11. Following the 100-percent fuel signal in phase III, a circuit is completed which energizes the clamshell solenoid-operated control valve, opening the clamshell arms. Simultaneously, the three threaded launch pins are retracted. Other circuits are completed which control the hydraulic system. The direction of hydraulic flow is reversed, the erector cylinder retracts, and the erecting-transporting boom is lowered (4 and 5, figure 5-6). When the boom reaches 45 degrees, it actuates the SAFE TO FIRE switch.

5-12. When the missile lifts off, the launching legs are mechanically retracted by springs. The fuel and liquid oxygen masts are mechanically retracted. A lanyard attached to leg No. six positions a flow control valve on the umbilical mast platform. Hydraulic pressure released by the flow control valve is exerted on the umbilical mast cylinder, retracting the mast and separating the plug carrier from the missile. Mechanical linkage which gradually closes the port decreases the retraction speed of the umbilical mast. Retraction ceases when the mast is approximately thirty-four degrees from the vertical position.

5-13. CHECKOUT.

5-14. The local control panel of the hydraulic pumping unit (3, figure 5-2) and the hydraulic supply unit of the erecting-transporting boom (figure 5-3) may be used to initiate operational sequences for the purpose of checking out the erecting-launching mount system. The hydraulic pumping unit, the erecting-transporting boom, and the erecting-launching mount may be checked out individually or as a system. The same controls and simulated signals are used in troubleshooting procedures to isolate and correct system and component failures. A jog and emergency control may be used to raise or lower the boom in case of emergency. This control bypasses the safety interlocks of the system.

SECTION VI

PROPELLANT TRANSFER SYSTEM

6-1. PURPOSE.

6-2. The propellant transfer system automatically controls the flow of liquid oxygen, fuel, and compressed nitrogen gas to the missile during countdown. In standby condition the propellant transfer system stores the propellants and compressed nitrogen gas. The system also provides facilities for manual (1) unloading the propellants from the missile in case of an aborted countdown.

6-3. DESCRIPTION.

6-4. The launch emplacement propellant transfer system (figure 6-1) consists of the liquid oxygen transfer equipment, fuel transfer equipment, and electrical and pneumatic supply equipment. The system includes maintenance, servicing, and checkout equipment which is kept at the RIM building and dispatched to the launch emplacement (figure 6-1) as required.

Table 6-1. Propellant Transfer System Equipment

Equipment Name	*Index and Figure No.*	*Purpose*	*Characteristics*
Liquid Oxygen Storage Tank TMU-3/E	6-2	Stores and minimizes loss of liquid oxygen, also supplies liquid oxygen to missile tank.	Comprised of two concentric cylinders separated by an annular air-evacuated insulated filled material. Total capacity: 14,175 gallons.
Compressed Gas Cylinder Semi-trailers AF/M32A-17 (liquid oxygen side)	6-2	Stores and supplies compressed nitrogen gas for pressurizing liquid oxygen storage and missile tanks. Supplies purge pressure to liquid oxygen transfer equipment.	Two identical trailers, No. 1 and No. 2, connected to a single manifold. Each trailer contains 38 storage tubes. Total capacity (one trailer) 55,000 cu. ft.
Gas Pipeline Outfit GSU-17/E	6-2	Connects gas cylinder semi-trailers (liquid oxygen side) to tank end valve complex.	Comprised of 2-inch stainless steel piping with associated connecting fittings and supporting units.

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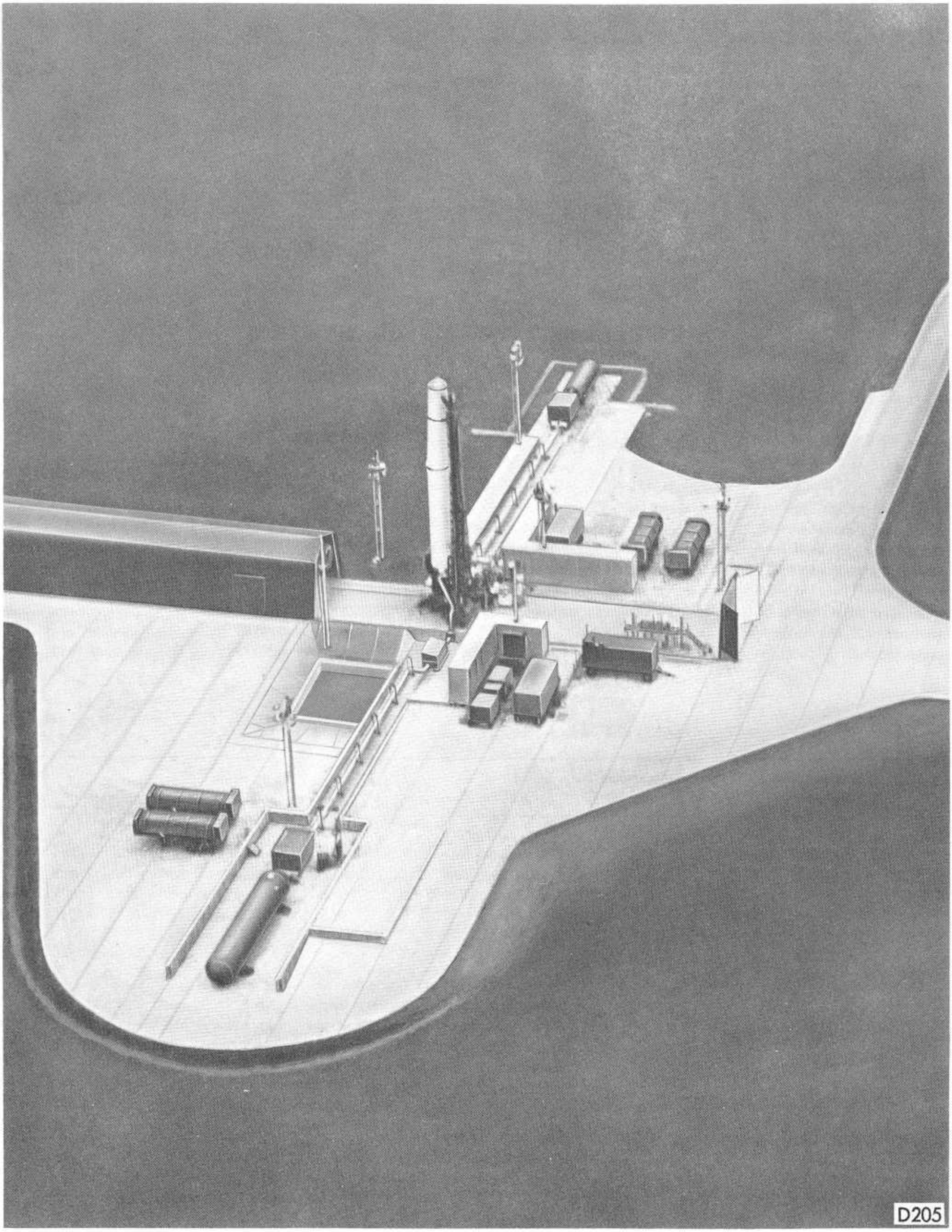


Figure 6-1. Launch Emplacement Propellant Transfer System

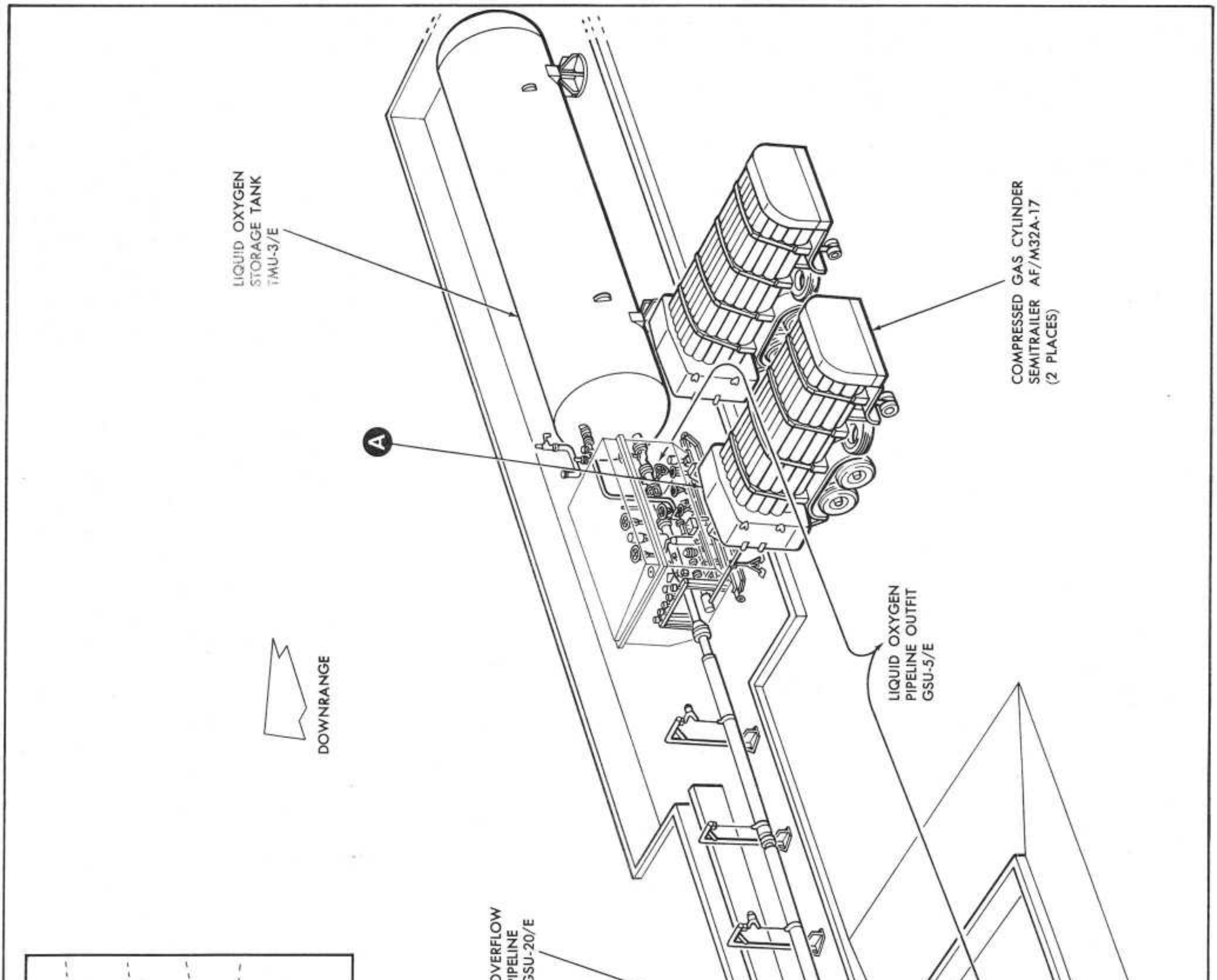


Figure 6-2. Liquid Oxygen Transfer Equipment

Table 6-1. Propellant Transfer System Equipment (Continued)

Equipment Name	*Index and Figure No.*	*Purpose*	*Characteristics*
Liquid Oxygen Pipeline Outfit GSU-5/E	6-2	Controls flow of liquid oxygen and compressed nitrogen gas to liquid oxygen storage and missile tanks.	Comprised of a liquid oxygen tank-end valve complex, liquid oxygen main transfer line, liquid oxygen missile-end valve complex, and associated connecting and supporting hardware. Major components comprising the valve complexes are: a gaseous nitrogen control manifold, vent valve, rapid and fine load valves, pressurizing valve, manual bypass valves, regulators, filters, associated piping and electrical cables, and interconnecting plumbing. Liquid oxygen fine flow rate: approximately 200 gpm. Liquid oxygen rapid flow rate: approximately 1200 gpm.
Overflow Pipeline GSU-20/E	6-2	Carries liquid oxygen overflow from the missile to the liquid oxygen pit.	Consists of a 3-inch stainless steel pipe covered with an insulation blanket.
Liquid Oxygen Side Junction Box GSU-8/E	6-2	Provides a protective housing for electrical and pneumatic connections at missile launch mount area.	Comprised of a steel angle-beam, covered by a ¼-inch steel plate. The sides are at a 45-degree angle from end walls perpendicular to base. Housing can withstand blast pressures of up to 8 psi.
Fuel Storage Tank TMU-4/E	7, 6-3	Stores fuel and supplies fuel to the missile fuel tank.	Stainless steel cylindrical tank externally insulated. Total capacity: approximately 6800 gallons.
Immersion Electric Heater HDK-5/F24A	6, 6-3	Maintains fuel in fuel storage tank at a temperature above 40°F at all times.	Self contained immersion type unit consisting of calrod elements and automatically operated by sensing devices.
Heater and stratification control panels	8, 6-3	Contain the components which monitor and control the operation of the fuel circulating pump and immersion electric heater.	Both panels are skid-mounted and interconnected. Controls are completely automatic and connected to fuel circulating pump and immersion electric heater.
Circulating pump	5, 6-3	Periodically recirculates fuel in fuel storage tank to prevent stratification.	Centrifugal motor-driven pump. Circulation rate 100 gallons per minute.

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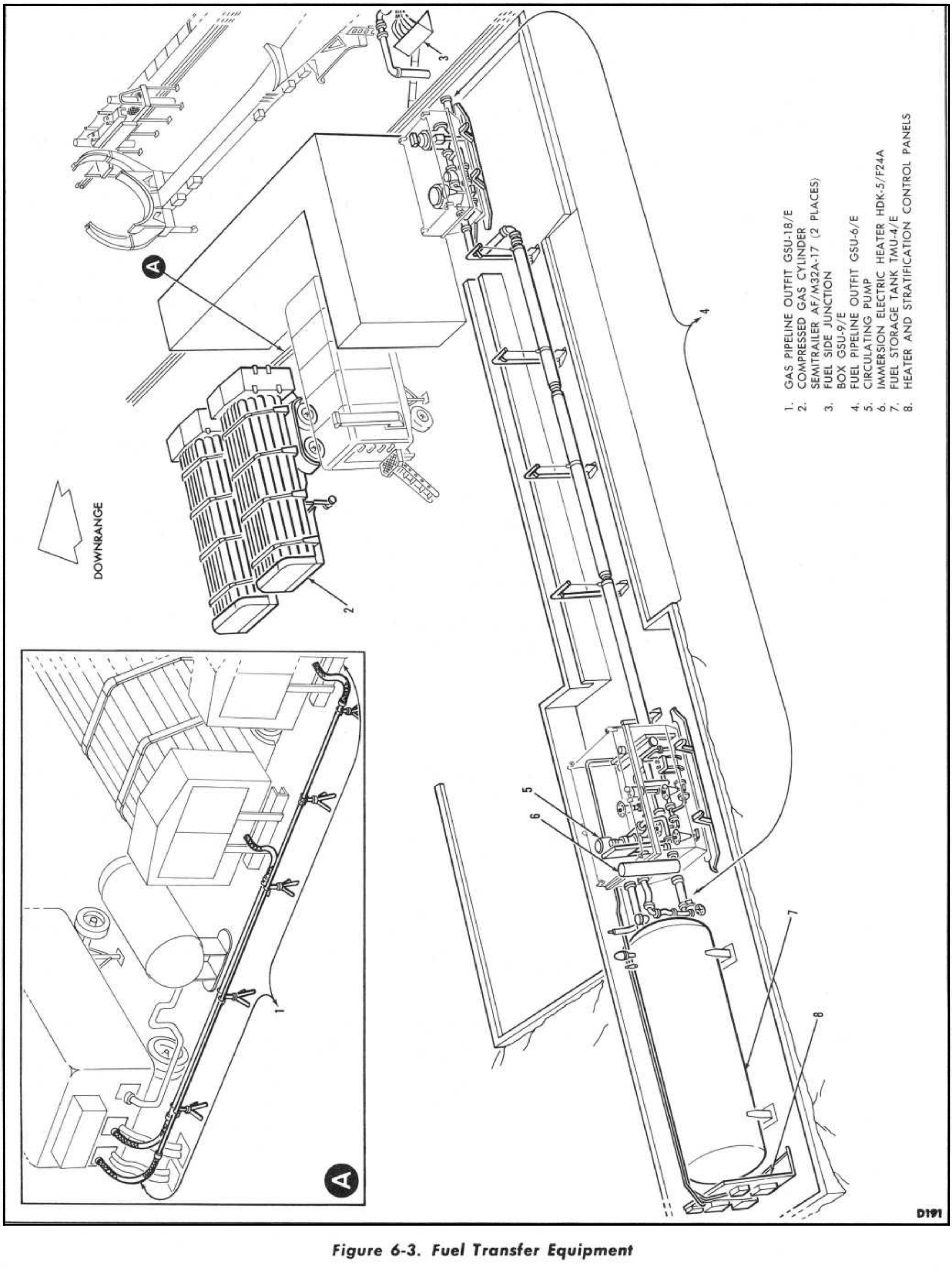


Figure 6-3. Fuel Transfer Equipment

Table 6-1. Propellant Transfer System Equipment (Continued)

Equipment Name	*Index and Figure No.*	*Purpose*	*Characteristics*
Fuel Pipeline Outfit GSU-6/E	4, 6-3	Controls flow of fuel and compressed nitrogen gas to fuel storage and missile tanks.	Comprised of a fuel tank-end valve complex, a fuel main transfer line, a fuel missile-end valve complex, and associated connecting and supporting hardware. Major components comprising the valve complexes are: a gaseous nitrogen control manifold, a rapid and fine load valve, manual bypass valves, regulators, filters, flowmeter, fuel circulating pump, associated piping and electrical cables, and interconnecting plumbing. Fuel fine flow rate: approximately 200 gpm. Fuel rapid flow rate: approximately 1200 gpm.
Compressed Gas Cylinder Semitrailer AF/M32A-17 (fuel side)	2, 6-3	Stores and supplies compressed nitrogen gas to hydro-pneumatic controller for pressurizing fuel storage and missile tanks, operating pneumatic valves throughout the system, and for checkout and maintenance requirements.	Two identical trailers (firing, purge and checkout), each consisting of 38 storage tubes and independently connected to the hydropneumatic controller. Total capacity one trailer approximately 55,000 cu. ft. Firing trailer is used exclusively for actual countdown operations. Purge and checkout trailer is used for maintenance and checkout operations and for fuel subsystem purge.
Fuel Side Junction Box GSU-9/E	3, 6-3	Provides protective housing for electrical and pneumatic connections at missile launch mount area.	Comprised of a steel angle-beam, covered by a ¼-inch steel plate. Sides are at a 45-degree angle with end walls perpendicular to the base. Housing can withstand blast pressures up to 8 psig.
Gas Pipeline Outfit GSU-18/E	1, 6-3	Connects gas cylinder semitrailers (fuel side) to hydropneumatic controller.	Comprised of 1- and 2-inch stainless piping with associated connecting and supporting hardware.
High-Pressure Gas Storage Tank TMU-6/E	6, 6-4	Stores and supplies high-pressure nitrogen gas to the hydropneumatic controller for pressurizing the missile bottles and re-entry vehicle tanks.	Cylindrical tank, constructed of laminated steel and mounted on two identical saddle supports. Internal volume is approximately 55 cu. ft. Maximum working pressure: approximately 6000 psig.
Trailer-Mounted Hydropneumatic Systems controller AF/M46A-1	5, 6-4		

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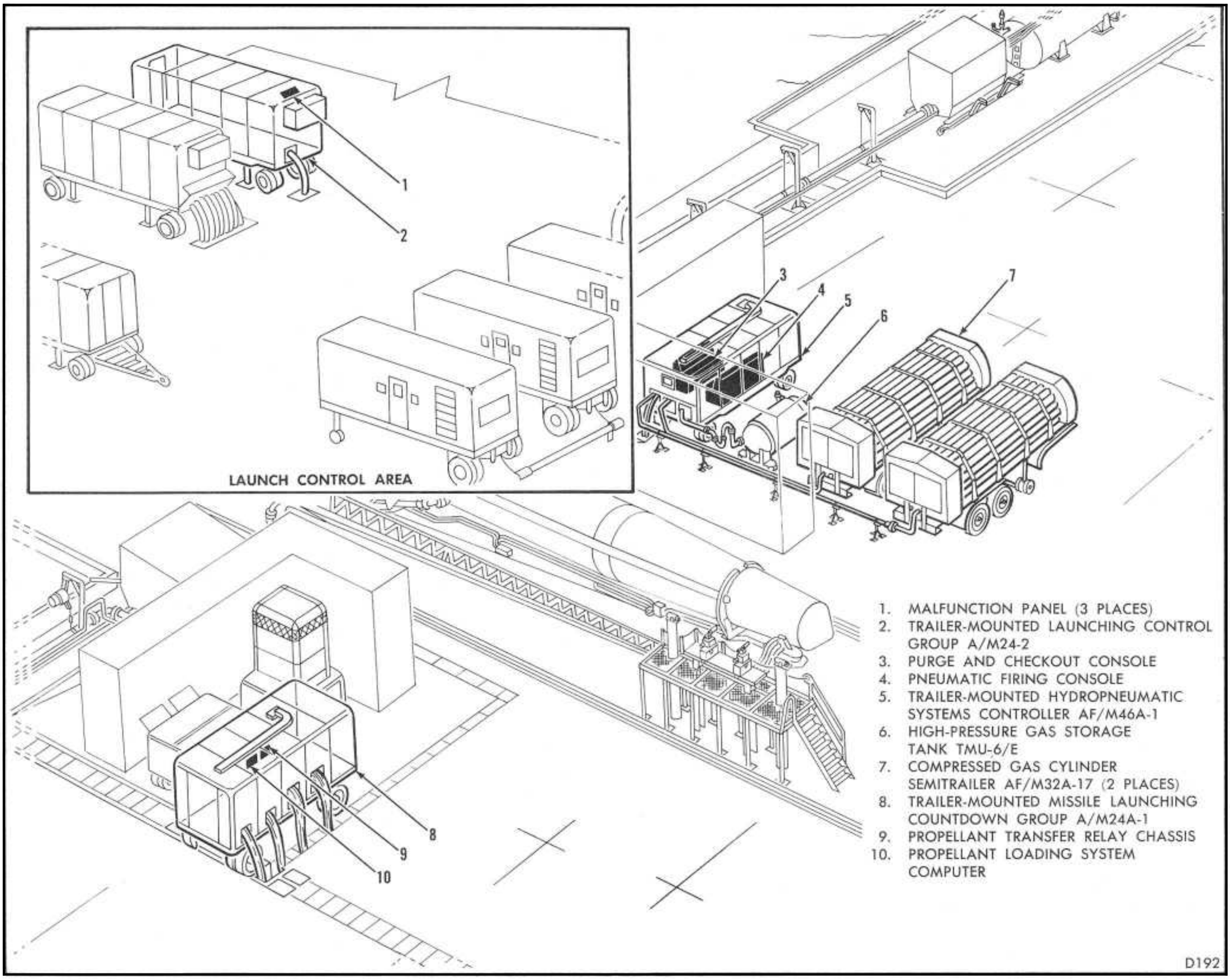


Figure 6-4. Propellant Transfer Electrical and Pneumatic Supply Equipment

Table 6-1. Propellant Transfer System Equipment (Continued)

Name Equipment	*Index and Figure No.*	*Purpose*	*Characteristics*
Pneumatic firing console	4, 6-4	Regulates and distributes compressed nitrogen gas in sequence and at various pressures to proper components during countdown.	Comprised of metal cabinet with access doors on lower front side and regulating controls and gages mounted on the oblique face of console. Major components comprising the console are: a control manifold pressurizing valve, fuel storage tank pressurizing valve, missile fuel tank prepressurizing valve, manual bypass valves, filter, regulators, associated piping electrical cables, and interconnecting plumbing.

(Continued on Page 6-8)

Table 6-1. Propellant Transfer System Equipment (Continued)

Equipment Name	*Index and Figure No.*	*Purpose*	*Characteristics*
Purge and checkout console	3, 6-4	Supplies compressed nitrogen gas at regulated pressures to missile and proper components during checkout and maintenance operations. Provides purge pressure for missile fuel tank.	Comprised of metal cabinet with access doors on lower front side and regulating controls and gages mounted on the oblique face of console. Major components comprising the console are: a filter, manual valves, regulators, and associated interconnecting piping.
Trailer-Mounted Missile Launching Countdown Group A/M24A-1	8, 6-4		
Propellant loading system computer	10, 6-4	Automatically computes and controls amount of fuel loaded into missile during countdown.	Comprised of a chassis and panel assembly which houses electrical monitoring and control circuitry.
Propellant transfer relay chassis	9, 6-4	Houses electrical circuitry which controls automatic sequencing of pneumatic and solenoid valves during countdown.	Completely automatic chassis dependent upon external signals to start and stop automatic sequencing during countdown.
Trailer-Mounted Launch Control Group A/M24A-2	2, 6-4		
Malfunction panel	1, 6-4	Provides visual indication of where in the system a malfunction occurs.	Consists of 30 malfunction lights, nine of which indicate propellant transfer system malfunction areas.
Trailer-Mounted Vacuum Pump PMU-1/M or PMU-1A/M	6-5	Used to obtain and maintain an air-evacuated condition within liquid oxygen storage tank annular space as required.	Consists of a vacuum pump mounted on a trailer assembly, 1-hp. electric motor, operating controls, and connecting hoses.
Trailer-Mounted Fuel Filter Unit GSU-7/M	6-5	To filter and dewater fuel periodically and during filling or draining operations.	Consists of a mechanical water separator, electrically driven centrifugal pump, 5-hp. filter assembly, operating controls, and connecting hoses.
Power-Driven Reciprocating Compressor A/M-32A-27 or ACU-1/M	6-5	To charge and replenish the high-pressure gas storage tank as required.	Compressor consists of a five-stage compressor, powered by a gasoline engine, operating and monitoring controls, and connecting hoses.

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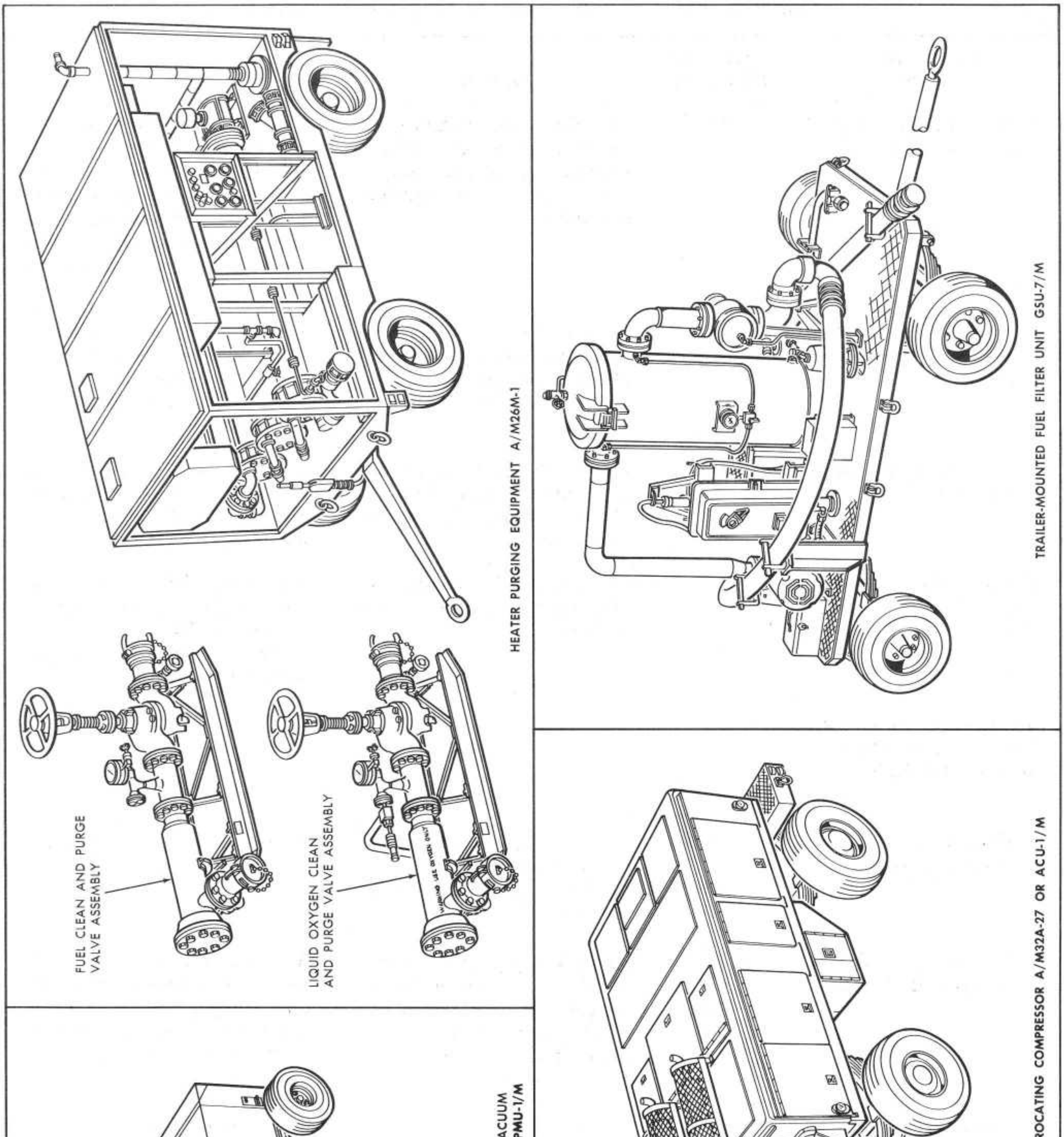
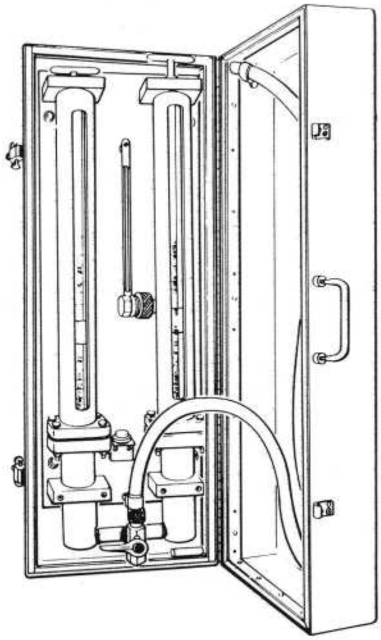


Figure 6-5. Propellant Transfer Maintenance and Servicing Equipment

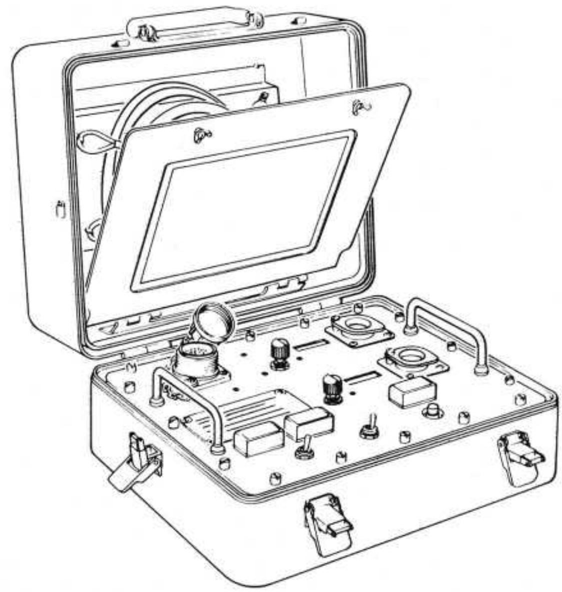
Table 6-1. Propellant Transfer System Equipment (Continued)

Equipment Name	*Index and Figure No.*	*Purpose*	*Characteristics*
Heater Purging Equipment A/M26M-1	6-5	Provides heated trichloroethylene and nitrogen gas for flushing and purging liquid oxygen system during maintenance operations.	Comprised of a heater-trailer, two clean and purge valve assemblies, and associated connecting equipment. Heater-trailer is a self-contained gasoline heater unit and is equipped with operating and monitoring controls.
Liquid oxygen clean and purge valve assembly		Provides filtering, contamination monitoring, and control of liquid oxygen flow during maintenance operations.	Stainless steel sled-mounted unit comprised of a filter, relief valve, associated manual control valves, and connecting adapters.
Fuel clean and purge valve assembly		Provides filtering, contamination monitoring, and control of fuel during maintenance operations.	Stainless steel sled-mounted unit comprised of a filter, associtated manual control valves, and connecting adapters.
Guided Missile Maintenance Tool Kit KMU-47/E		Provides tools for maintenance of propellant transfer system equipment.	Kit is comprised of wrenches and adapters of special shape to fit inaccessible locations. Included are special high-torque wrenches and adapters.
Trailer-Mounted Ballistic Missile System Checkout Station TTU-92/M			
Propellant transfer checkout panel	1, 6-6	Provides the monitoring and control for accomplishing checkout and maintenance operations.	Consists of two panels mounted on a chassis.
Rocket Engine Checkout Control Monitor	2, 6-6	For manually positioning missile fuel and missile liquid oxygen tank vent valves, and missile liquid oxygen tank pressurizing valve for checkout requirements.	Manually or automatically controls and monitors rocket engine components and propellant missile tank valves during checkout operations.
Pneumatic Pressure Panel, also Pneumatic Flow and Pressure Panel	4, 6-6 3, 6-6	To pressurize, monitor, and control pneumatic pressures to missile fuel tank and missile liquid oxygen tank during checkout operations.	Panels consist of pressure regulators and gages mounted on an equipment rack, and are utilized during engine and missile propellant tanks checkout.
Computer-Test Set TTK-58/E		To perform an operational check of propellant loading system computer.	Portable suitcase-type checkout unit comprised of electrical components, monitoring and operating controls.

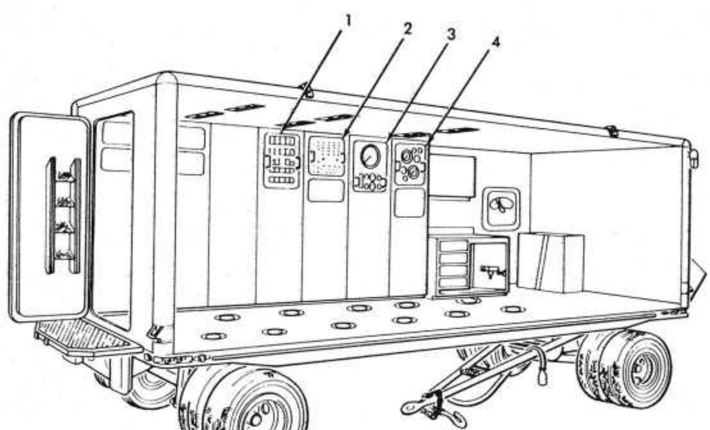
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DENSITY TESTER TTK-53/E32A

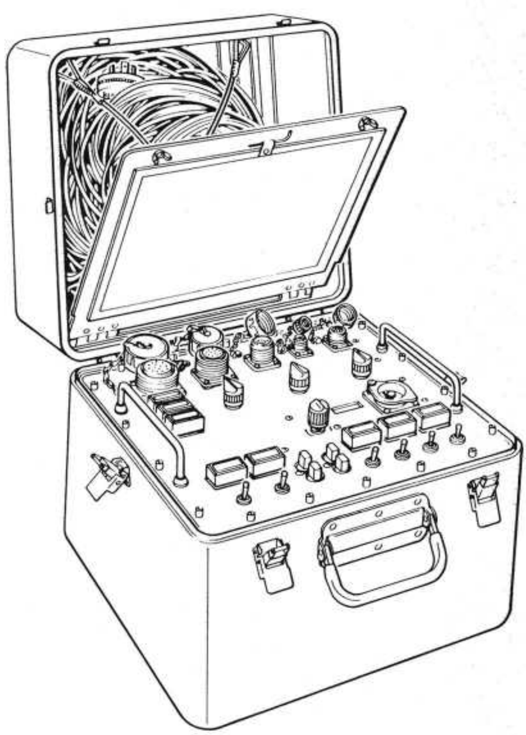


COMPUTER-TEST SET TTK-58/E



TRAILER-MOUNTED BALLISTIC MISSILE SYSTEM CHECKOUT STATION TTU-92/M

1. PROPELLANT TRANSFER CHECKOUT PANEL
2. ROCKET ENGINE CHECKOUT CONTROL MONITOR
3. PNEUMATIC FLOW AND PRESSURE PANEL
4. PNEUMATIC PRESSURE PANEL



COMPUTER-TEST SET SIMULATOR SMU-17/E

D194

Figure 6-6. Propellant Transfer System Checkout Equipment

Table 6-1. Propellant Transfer System Equipment (Continued)

Equipment Name	Index and Figure No.	Purpose	Characteristics
Computer-Test Set Simulator SMU-17/E	6-6	Check functionally entire operating range of propellant loading system computer.	Portable suitcase-type checkout unit comprised of electrical components and associated connecting cables.
Density Tester TTK-53/E32A	6-6	To determine periodically density of fuel in storage tank.	Portable suitcase-type instrument comprised of a thermometer, sampling chambers, level, and connecting hose assembly.

6-5. OPERATION.

6-6. GENERAL.

6-7. Periodically the propellant transfer system is checked operationally to insure compatibility of missile and ground support equipment and to verify operational potential of the propellant transfer system.

6-8. During servicing operations the propellant transfer system is flushed and purged, regulators are adjusted, and the propellant and nitrogen gas storage tanks filled.

6-9. During checkout operations the propellant transfer system is leak-checked, all manual valves are positioned, and the electrically controlled valves functionally checked. If malfunctions are encountered, troubleshooting is performed to isolate and correct them. Upon satisfactory completion of maintenance, servicing, and checkout operations, the propellant transfer system is ready (or standby) condition.

6-10. In ready condition, a constant blanket purge pressure (2 psig) of gaseous nitrogen is maintained in the liquid oxygen transfer system and in the missile fuel tank. This positive pressure prevents the entry of moisture and contaminants.

6-11. During the automatically sequenced loading operations at countdown the propellants are simultaneously pressure-loaded (figure 6-7) into the missile. The initiation of a function depends on the successful completion of the preceding function. As the sequence progresses, each electrically controlled valve in the propellant transfer system is automatically opened and closed in the proper order to transfer and control the flow of propellants and compressed nitrogen gas into the missile. If the system malfunctions during operations the loading sequence is automatically stopped and does not resume until the malfunction has been corrected or manual control initiated.

6-12. COUNTDOWN.
(See figure 6-8.)

6-13. With the turning of the launch sequence start key, a circuit is completed and the start signal for propellant transfer preparation is transmitted to the propellant transfer system. The propellant loading system computer is activated and an automatic valve position and engine circuitry check is made.

6-14. The pneumatically operated valves in the system contain two-position switches which indicate valve position. All electrically controlled valves must be in the closed position except the liquid oxygen storage tank vent valve, which remains open for tank venting. If all valves are in the proper position, the automatic sequencing continues. The control manifolds pressurizing valve opens, allowing compressed nitrogen gas to enter the manifolds. The control manifolds provide pneumatic actuation for the electrically controlled valves. Simultaneously, the fuel circulation pump is started and the fuel is circulated within the fuel storage tank to insure uniform fuel density. The missile bottles pressurizing and missile liquid oxygen tank vent valves are also opened.

6-15. At the start of phase II the liquid oxygen storage tank vent valve is closed and the liquid oxygen storage tank is pressurized to prepare for liquid oxygen transfer. Erection of the missile in phase II provides the phase III start signal.

6-16. The phase III start signal results in the propellant transfer start signal, which in turn opens the liquid oxygen rapid load No. 1, No. 2, and liquid oxygen fine load valve. At this point in the propellant transfer, the missile liquid oxygen tank vent valve is closed for approximately 180 seconds to facilitate filling of the liquid oxygen start tank. Liquid oxygen is then pressure loaded into the missile until the 95-percent full level is reached. This initiates the liquid

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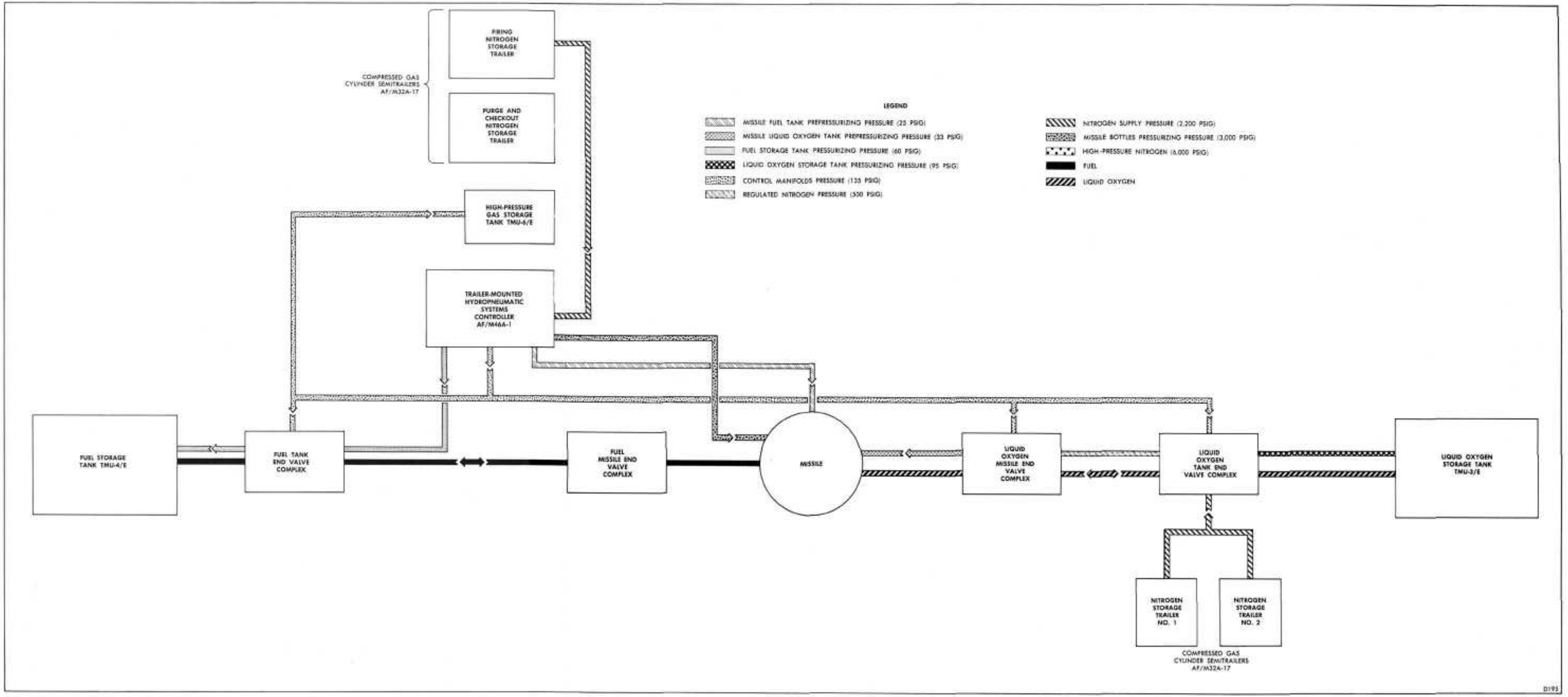


Figure 6-7. Propellant Transfer System — Block Diagram

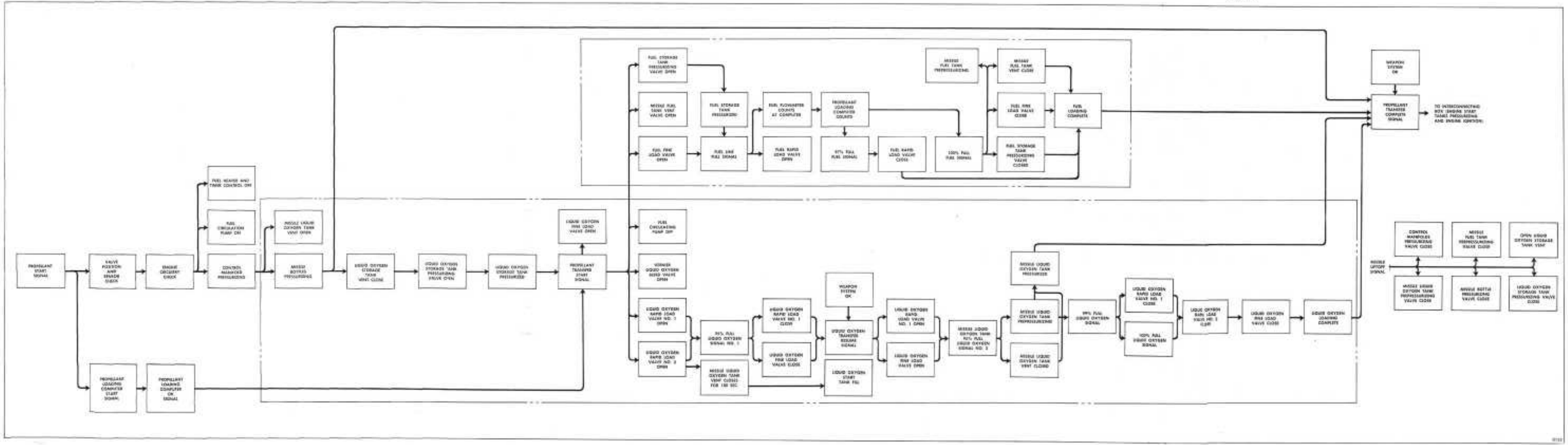


Figure 6-8. Propellant Loading Sequence – Data Flow Diagram

(Continued from Page 6-12)

oxygen transfer stop signal which closes the liquid oxygen rapid load No. 1 and liquid oxygen fine load valves. During the liquid oxygen transfer operation, fuel is also being loaded into the missile fuel tank. At phase III start, the fuel circulating pump is turned off, the missile fuel tank vent and fuel fine load valve are opened and the fuel storage tank is pressurized. Fuel now slowly flows into the fuel main transfer line. When the fuel main transfer line is full, a sensing device in the line initiates a signal which opens the fuel rapid load valve and energizes the propellant loading system computer.

Note

Vapor emitting from the missile vent valve at this time is due to the rapid boiloff (evaporation) of liquid oxygen entering the missile liquid oxygen tank.

6-17. The computer processes data pertaining to fuel density, temperature, and barometric pressure. This information, together with data concerning the engine and target selection, is analyzed by the computer and governs the amount of fuel loaded into the missile (liquid oxygen is always loaded to the 100-percent level). When the computer determines that the missile fuel tank is 97-percent full of the computed amount, the fuel rapid load valve is closed and fuel loading continues at fine load until 100 percent of the computed amount is reached. The computer now transmits a signal which closes the fuel fine load valve, the fuel storage tank pressurizing valve, and the missile fuel tank vent valve. This signal also initiates the prepressurization of the missile fuel tank and the fuel loading complete signal.

6-18. When the liquid oxygen level in the missile tank activates the 95-percent full float switch, a signal is transmitted, which along with the launcher clear signal, ends phase III and starts phase IV. Phase IV occurs as follows: Missile inverter is turned on; transfer of all missile power to internal; missile battery trickle charger is disconnected; slewing the engines on internal power. This ends phase IV and starts phase V. During this period, the liquid oxygen level drops below the 95-percent full float switch due to liquid oxygen boiloff. When the liquid oxygen loading sequence is resumed at the start of phase V, the 95-percent full level is again reached and a signal is transmitted closing the missile liquid oxygen tank vent valve and opening the missile liquid oxygen tank prepressurizing valve. Prepressurizing the missile liquid oxygen tank eliminates froth and foam in the missile liquid oxygen tank which could cause an erroneous float switch signal. Rapid loading of liquid oxygen continues until the 99-percent full float switch is reached. A signal is then transmitted, closing the liquid oxygen rapid load No. 1 valve. Fine loading continues until the 100-percent full float switch is reached. At this point, the liquid oxygen fine load and liquid oxygen rapid load No. 2 valves are closed, and the liquid oxygen loading complete signal is initiated.

6-19. After both the fuel and liquid oxygen loading complete signals have been initiated, a signal is transmitted which verifies that the missile bottles, the missile fuel tank and the missile liquid oxygen tank are pressurized. This signal also verifies the weapon system ok signal and that no holds have been imposed on the system. The resultant signal initiates the propellant transfer complete signal which initiates start tank pressurization and subsequent engine ignition. When main engine thrust is attained and the missile lifts off, a switch on the launch mount transmits a signal which closes all propellant transfer valves and reopens the liquid oxygen storage tank vent valve.

SECTION VII

MISSILE AIR-CONDITIONING SYSTEM

7-1. PURPOSE.

7-2. The missile air-conditioning system at the launch emplacement furnishes conditioned air continuously to the missile measurement unit, Gyro Stabilized Platform Group OA-2012/DKW-5, and to the missile guidance and engine and accessories sections. During wet exercises and launch countdowns, heated gaseous nitrogen is introduced into the engine section to reduce the hazard of accidental combustion.

7-3. At the RIM building, the missile air-conditioning system furnishes conditioned air continuously to the measurement unit and to the guidance section during checkout of the missile. The missile engine and accessories section does not require conditioned air while in the RIM building.

7-4. DESCRIPTION.
(See figures 7-1, 7-2, and 7-3.)

7-5. The missile air-conditioning system at the launch emplacement (figure 7-2) includes Trailer-Mounted Air Conditioner AF/M32C-1; umbilical lines, plug carrier, and air-conditioning ducts (1); guidance section (2); engine and accessories section (3); engine and accessories section supply ducts (4); power supply cable (5); communications cable (6); control cable (7); measurement unit supply duct (8); measurement unit return duct (9); nitrogen supply line (10); from the Trailer-Mounted Hydropneumatic Systems Controller AF/M46A-1; and guidance section supply duct (11). The air conditioner receives control signals from the Trailer-Mounted Launching Countdown Group A/M24A-1. The missile air-conditioning system at the RIM building (figure 7-3), includes: Trailer-Mounted Air Conditioner, AF/M32C-1(8); missile temperature sensors; guidance section supply duct splitter assembly (1); guidance section supply duct (2); measurement unit return duct (3); measurement unit supply duct (4); nitrogen supply inlet (5); engine and accessories section supply outlet (6); and guidance section supply duct (7). In the RIM building, the air conditioner receives control signals from the Trailer-Mounted Missile Launching Equipment Simulator SMU-14/M or SMU-18/M.

7-6. The trailer-mounted air conditioner is an unmanned item of ground support equipment. It contains three similar heating subsystems utilizing a common water-glycol supply and two seperate but similar refrigeration subsystems.

7-7. Temperature sensors send signals to the air conditioner when conditioned air is required to maintain correct temperatures in the engine and accessories section, guidance section, and measurement unit of the missile.

7-8. Two 8-inch and two 3-inch ducts are used at the launch emplacement to convey conditioned air to the missile. One 8-inch duct conveys air to the engine section and the other conveys air to the guidance section. The two 3-inch ducts are used to supply air to and return air from, the measurement unit. When the air conditioner is used in the RIM building the same size and number of ducts are used for the guidance section and measurement unit. The engine and accessories section duct is not used because conditioned air to the engine is not required while the missile is in the RIM building.

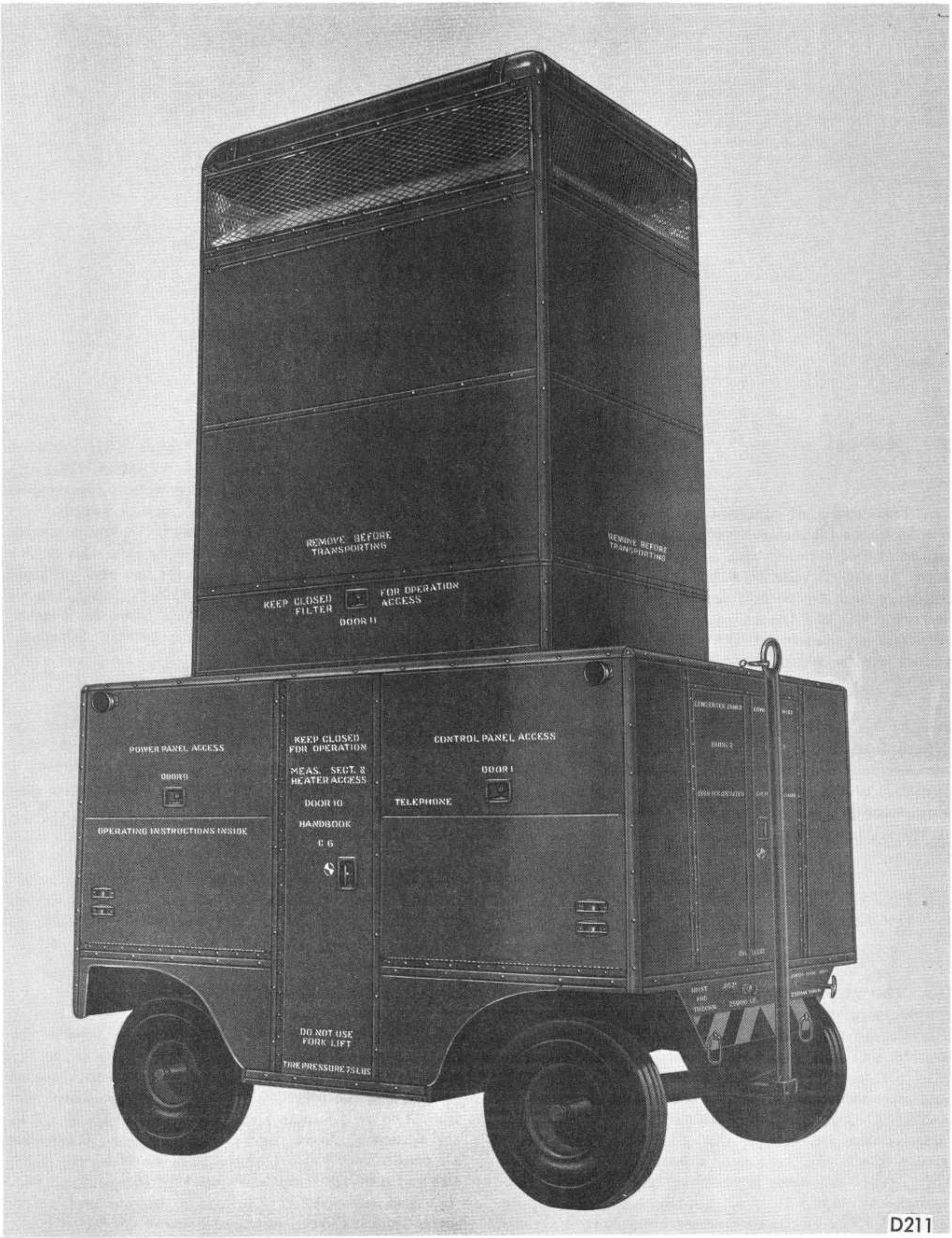
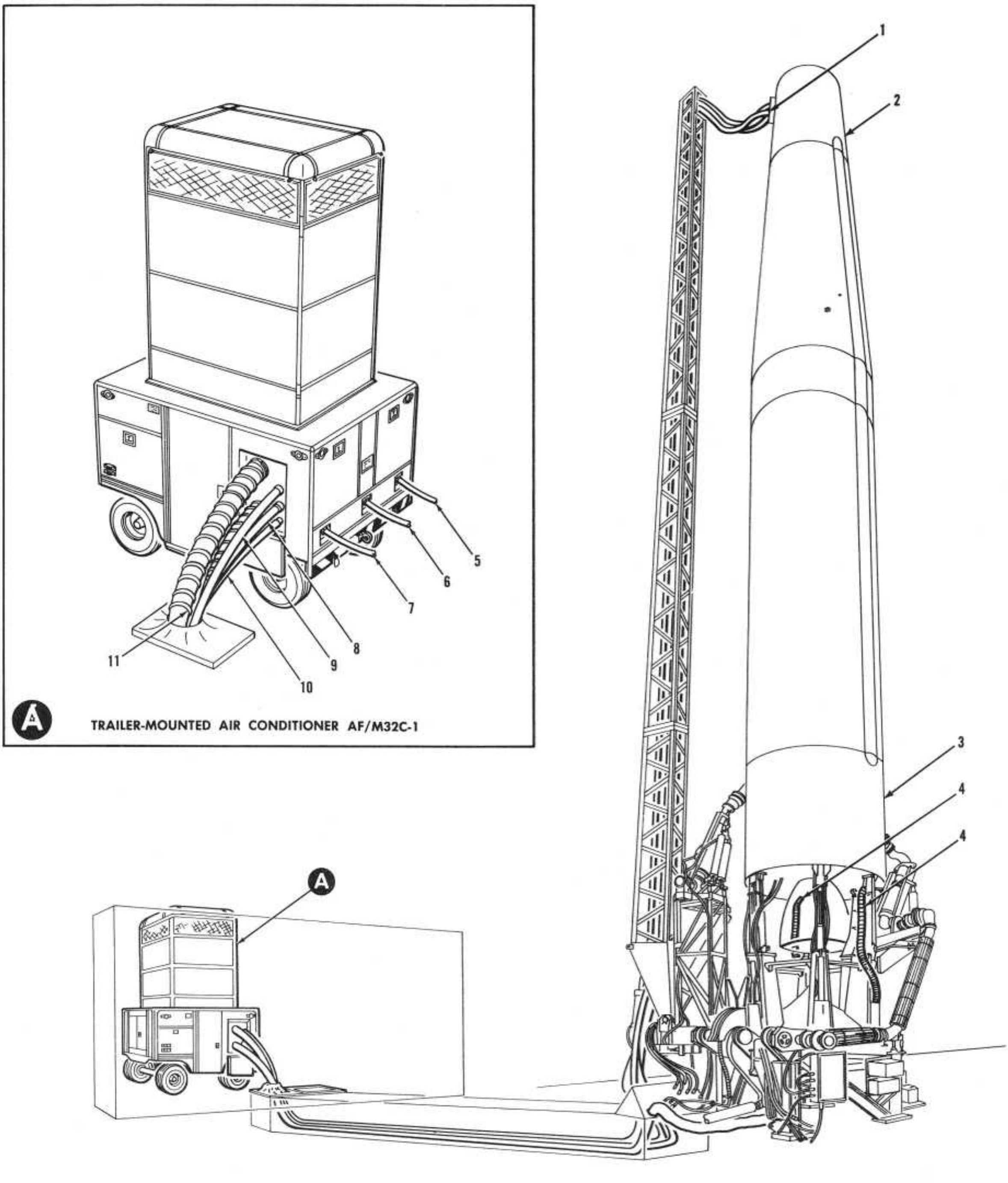


Figure 7-1. Trailer-Mounted Air-Conditioner AF/M32C-1 or A/M32C-8



1. UMBILICAL LINES, PLUG CARRIER, AND AIR-CONDITIONING DUCTS
2. GUIDANCE SECTION
3. ENGINE AND ACCESSORIES SECTION
4. ENGINE AND ACCESSORIES SECTION SUPPLY DUCT
5. POWER SUPPLY CABLE
6. COMMUNICATIONS CABLE
7. CONTROL CABLE
8. MEASUREMENT UNIT SUPPLY DUCT
9. MEASUREMENT UNIT RETURN DUCT
10. NITROGEN SUPPLY LINE
11. GUIDANCE SECTION SUPPLY DUCT

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Figure 7-2. Missile Air-Conditioning System at Launch Emplacement

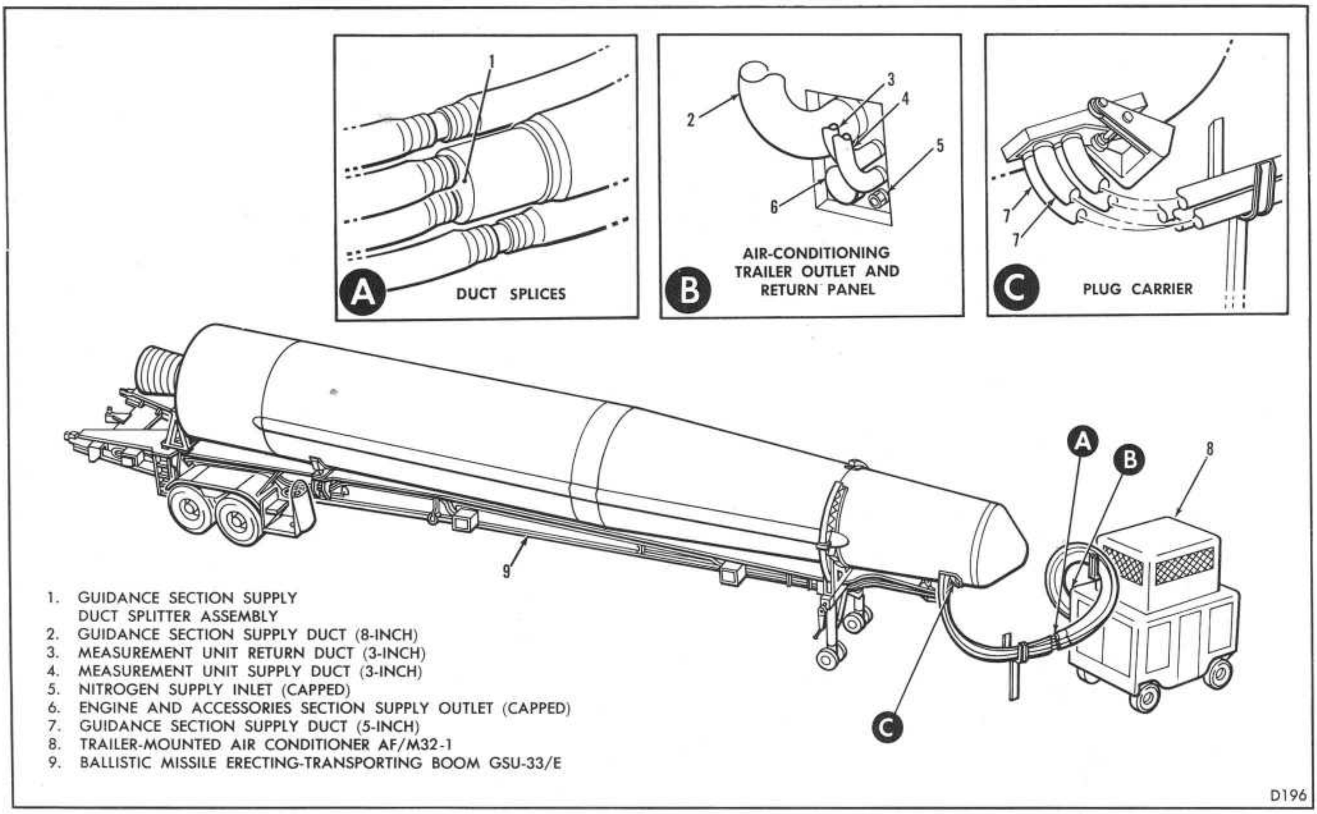


Figure 7-3. Missile Air-Conditioning System at RIM Building

7-9. OPERATION.

7-10. The missile air-conditioning system (figure 7-4) is made up of three independently controlled and separately functioning subsystems. Operation of these subsystems (engine section, guidance section, and measurement unit) is controlled by the temperature sensors in relation to the individual subsystems. The water-glycol heating system is the only portion of the air conditioner that is common to all three subsystems. This heating system provides heated water-glycol to heat the air for each of the subsystems.

7-11. ENGINE AND ACCESSORIES SECTION AIR-CONDITIONING SUBSYSTEM. (See figure 7-5.)

7-12. The engine section air-conditioning subsystem supplies heated air to the missile to maintain engine section temperature at or approximately 6°F. At the start of countdown, an automatic signal from the launching countdown group places the engine section subsystem in operation. This signal also opens the nitrogen supply valve in the hydropneumatic systems controller. As liquid oxygen loading begins, the nitrogen purge signal is initiated in the launching countdown group and transmitted to the air conditioner. This signal starts the nitrogen purge of the missile engine section, eliminating the fire hazard caused by possible liquid oxygen or fuel leakage in the missile. The same signal also causes the engine section subsystem to heat the air-nitrogen mixture to overcome the cooling effect of the liquid oxygen on the missile engine and accessories section.

7-13. When a technical hold is imposed the engine section subsystem continues to blow the heated air-nitrogen mixture into the missile engine and accessories section. The amount of nitrogen introduced into the engine section, during a hold after liquid oxygen loading has begun, can be reduced when no liquid oxygen or fuel leaks are detected by depressing the nitrogen purge damper release button. If the hold is imposed prior to liquid oxygen loading, the nitrogen supply may be shut off manually in the hydropneumatic systems controller.

7-14. GUIDANCE SECTION AIR-CONDITIONING SUBSYSTEM. (See figure 7-6.)

7-15. The guidance section air-conditioning subsystem supplies cooled, heated, or ambient air to the missile to maintain a guidance section temperature between

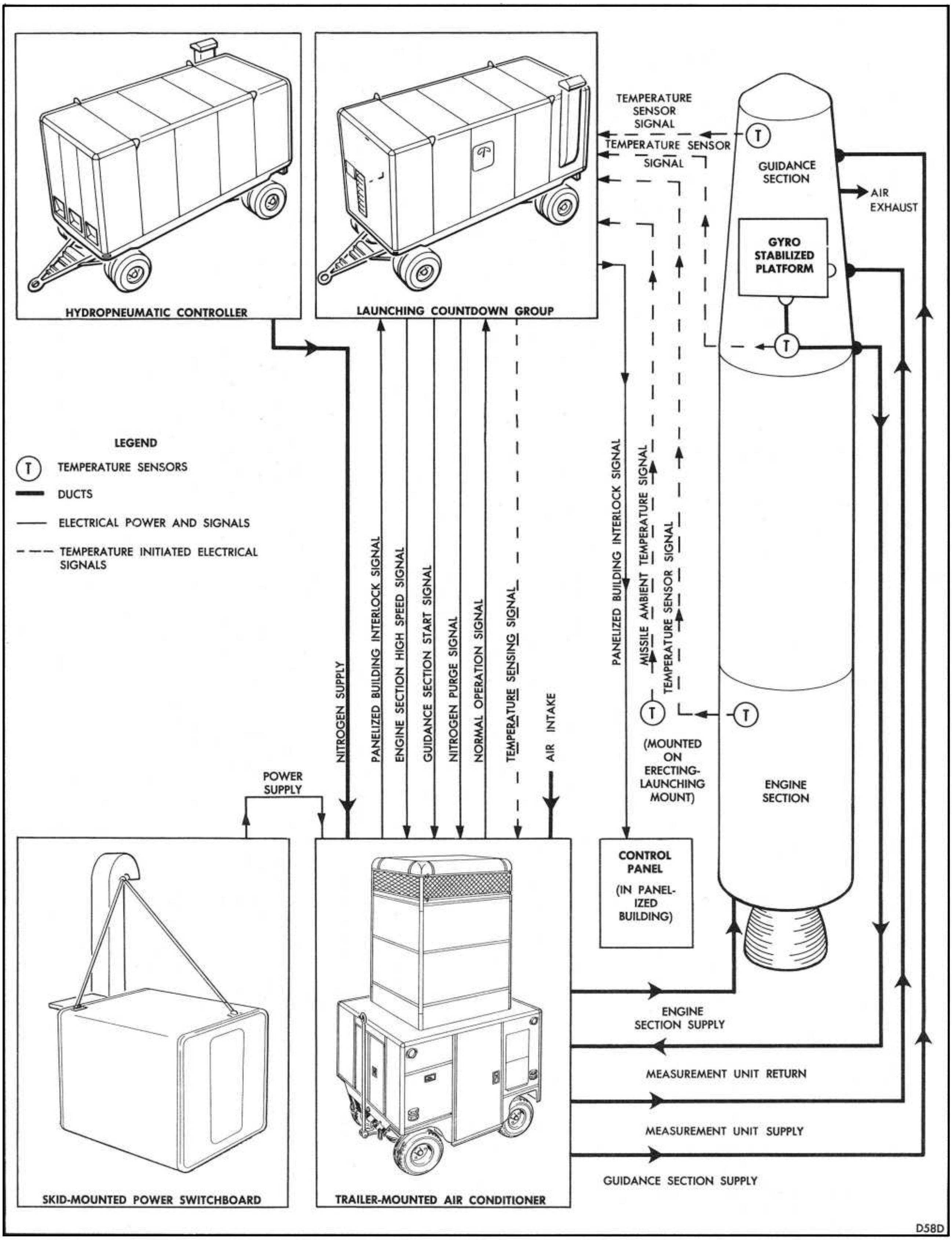


Figure 7-4. Missile Air-Conditioning System — Data Flow Diagram

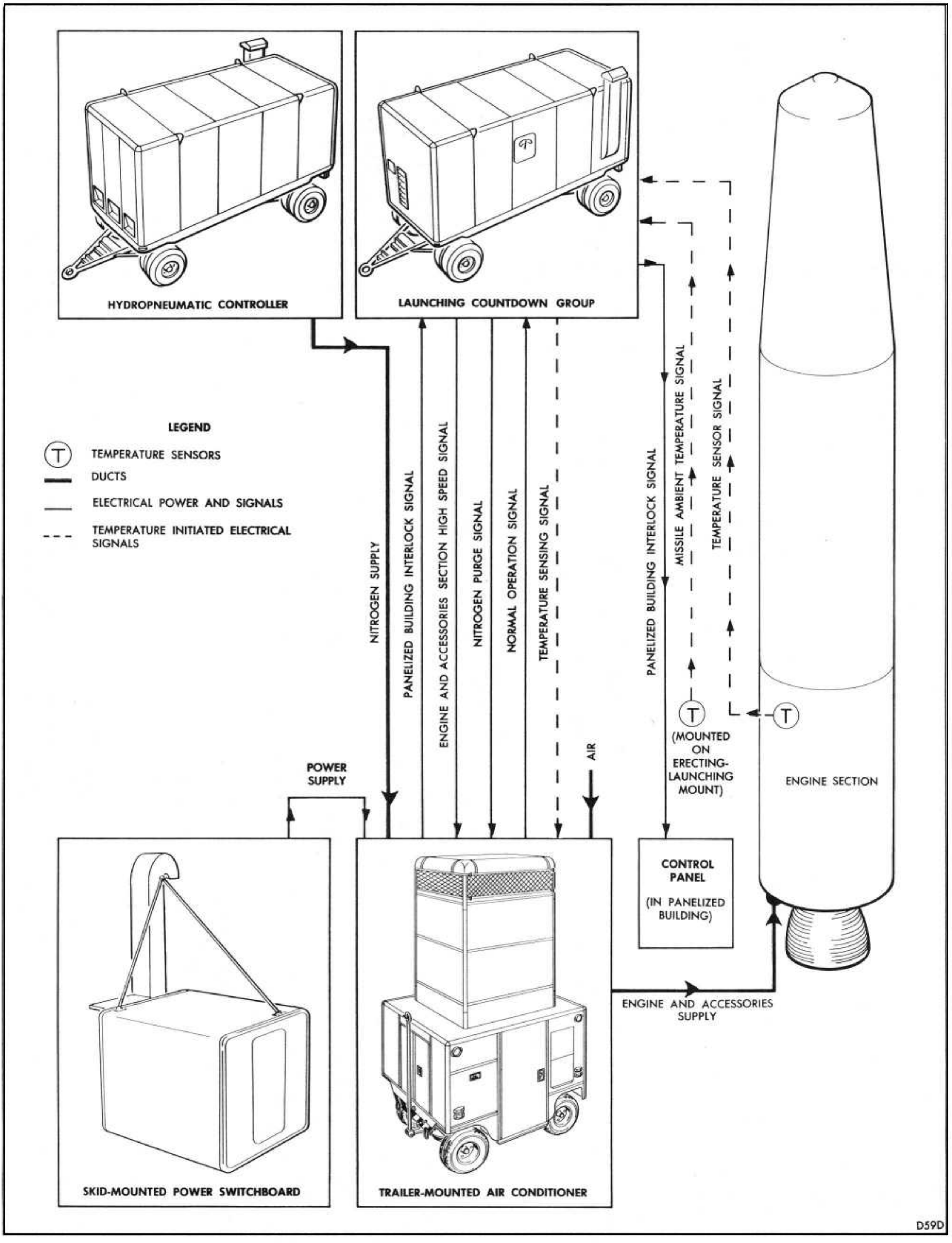


Figure 7-5. Engine and Accessories Section Air-Conditioning Subsystem — Data Flow Diagram

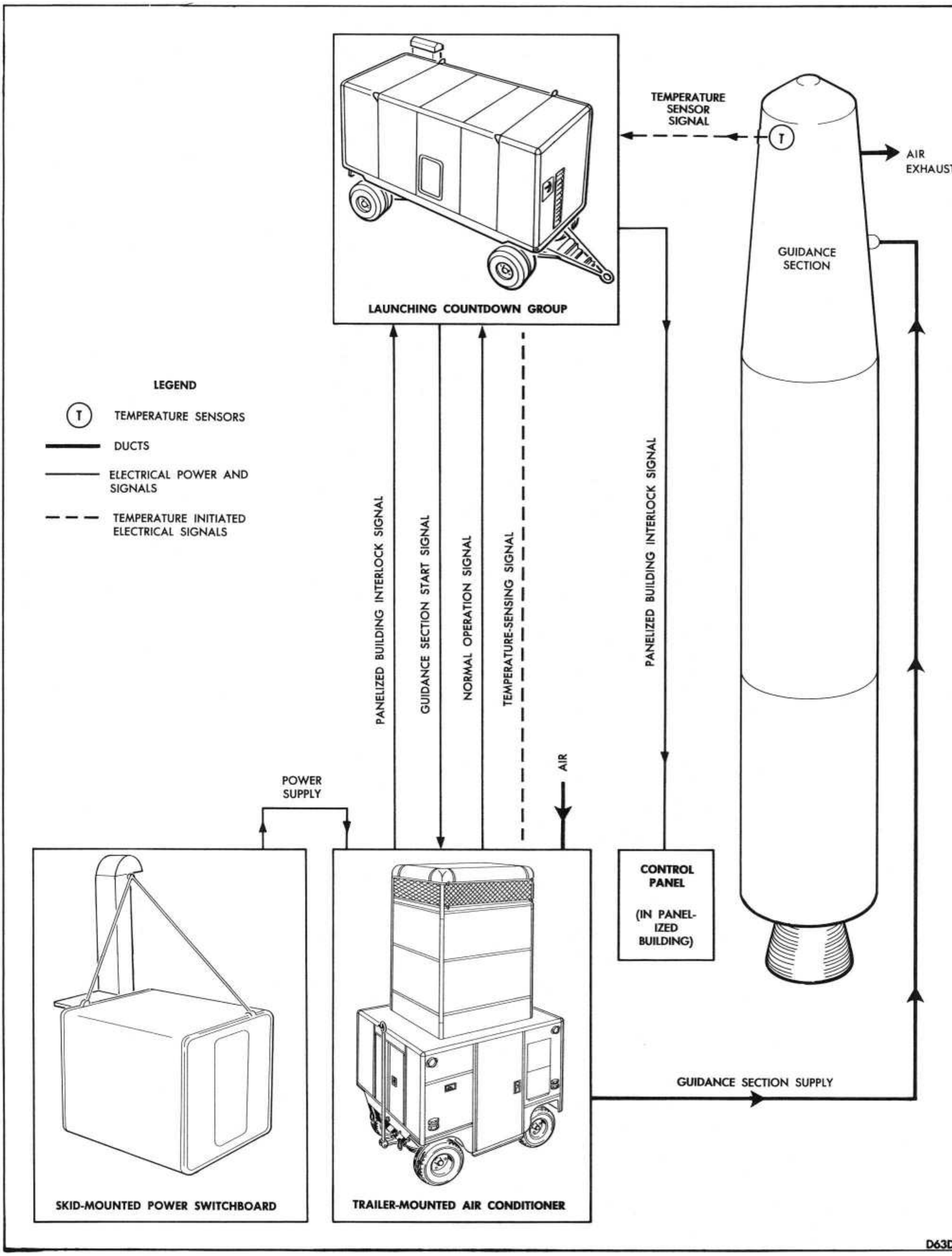


Figure 7-6. Guidance Section Air-Conditioning Subsystem — Data Flow Diagram

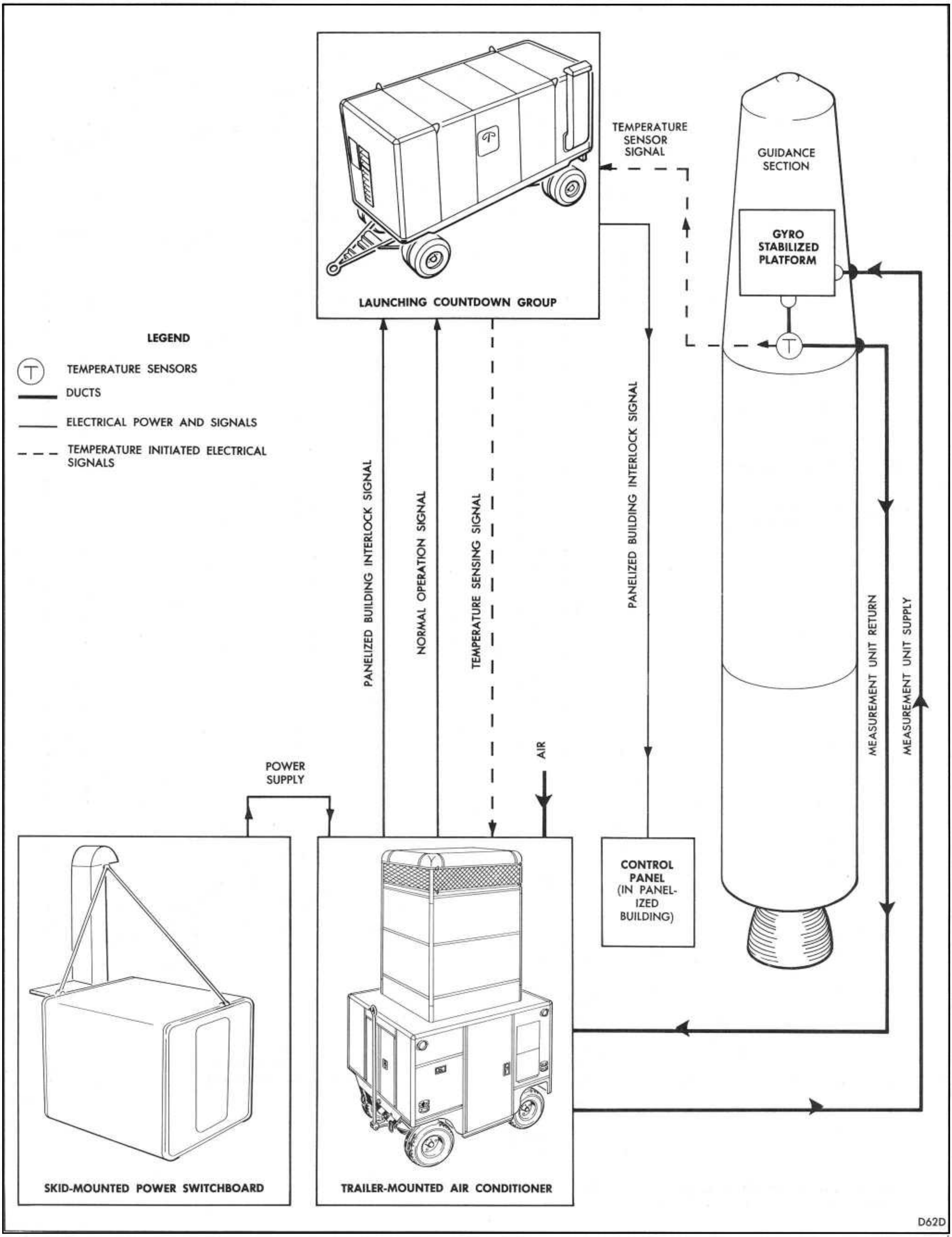


Figure 7-7. Measurement Unit Air-Conditioning Subsystem — Data Flow Diagram

340°F (1.1°C) and 125°F (51.7°C). This temperature range must be maintained in the guidance section of the missile throughout the ready condition. To maintain these temperatures, the guidance section subsystem supplies heated air at missile temperatures of 45°F (7.1°C) or below. At missile temperatures between 45°F (7.2°C) and 52°F (11.1°C) the guidance section subsystem blower supplies ambient air. Between 52°F (11.1°C) and 80°F (26.7°C) no air is supplied to the guidance section. When the guidance section temperature is between 80°F (26.7°C) and 115°F (46.1°C) the blower again operates to supply ambient air to the missile. Temperatures of 115°F and above cause the guidance section subsystem refrigeration unit to cool the air being supplied to the guidance section of the missile.

7-16. During countdown, the guidance start signal, originating in the launching countdown group, causes the refrigeration unit to supply cooled air to the missile when a guidance section temperature of 80°F is reached.

7-17. MEASUREMENT UNIT AIR-CONDITIONING SUBSYSTEM.

(See figure 7-7.)

7-18. The measurement unit air-conditioning subsystem continuously recirculates conditioned air through a supply duct and a return duct to maintain the missile measurement unit temperature within prescribed limits. A temperature sensor mounted in the exit airstream of the missile measurement unit, and two temperature-sensing elements mounted in the stream of air being delivered to the missile measurement unit, control the operation of the air-conditioning subsystem. These temperature sensors control the mixing of hot and cold air coming from the heating and refrigeration units. The missile measurement unit temperature must be maintained within prescribed limits at all times during a ready or countdown condition, or during checkout of the missile measurement unit in the RIM building.

SECTION VIII

ROCKET ENGINE PROPULSION SYSTEM

8-1. PURPOSE.

8-2. The rocket engine propulsion system provides the thrust (figure 8-1) required to propel the missile and make flight-path control corrections.

8-3. DESCRIPTION.

8-4. The rocket engine propulsion system comprises a power package, two missile propellant tanks (fuel tank and liquid oxygen tank), associated ducting, and valves. The power package includes a main engine and two vernier engines, all are single-start, bipropellant rocket engines of fixed and calibrated thrusts. Other subsystems control, regulate, and sustain the components of the engine system. Ground support equipment is provided for maintenance and checkout.

8-5. Table 8-1 describes the components and subordinate systems involved in the operation of the rocket engine propulsion system.

Table 8-1. Components and Subsystems of the Rocket Engine Propulsion System

Equipment Name	*Index and Figure No.*	*Purpose*	*Characteristics*
Main Engine	8-2	Provides required thrust to propel missile, also provides attitude control capabilities.	Develops 150,000 pounds of thrust. Composed of a fuel-cooled thrust chamber, turbopump, and various supporting subsystems.
Turbopump	8-2	Accelerates flow of propellants for mainstage operation.	Composed of two single-entry, centrifugal pumps (mounted back to back on each side of gearcase), a turbopump gearbox, an accessory drive adapter, and an impulse type, two-stage pressure-compounded turbine.
Vernier engines	8-2 8-9	Provide attitude capabilities during mainstage operation and, through an additional 9 seconds maximum operation after main engine cutoff, provide any final velocity and attitude corrections.	Develops 1000 pounds of thrust each. Composed of a fuel-cooled thrust chamber, an engine thrust frame, and various supporting components.

(Continued on Page 8-4)

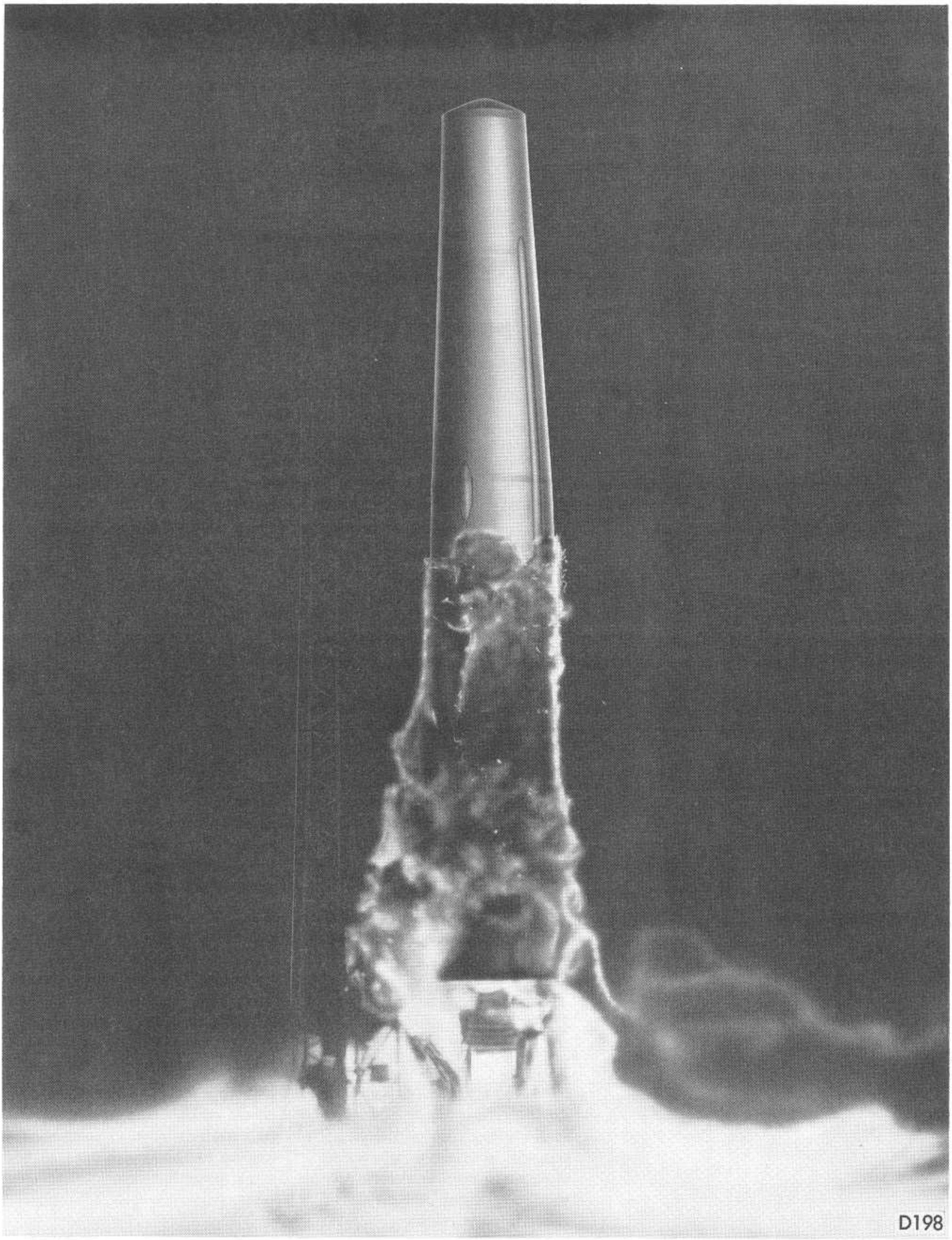


Figure 8-1. Rocket Engine Propulsion

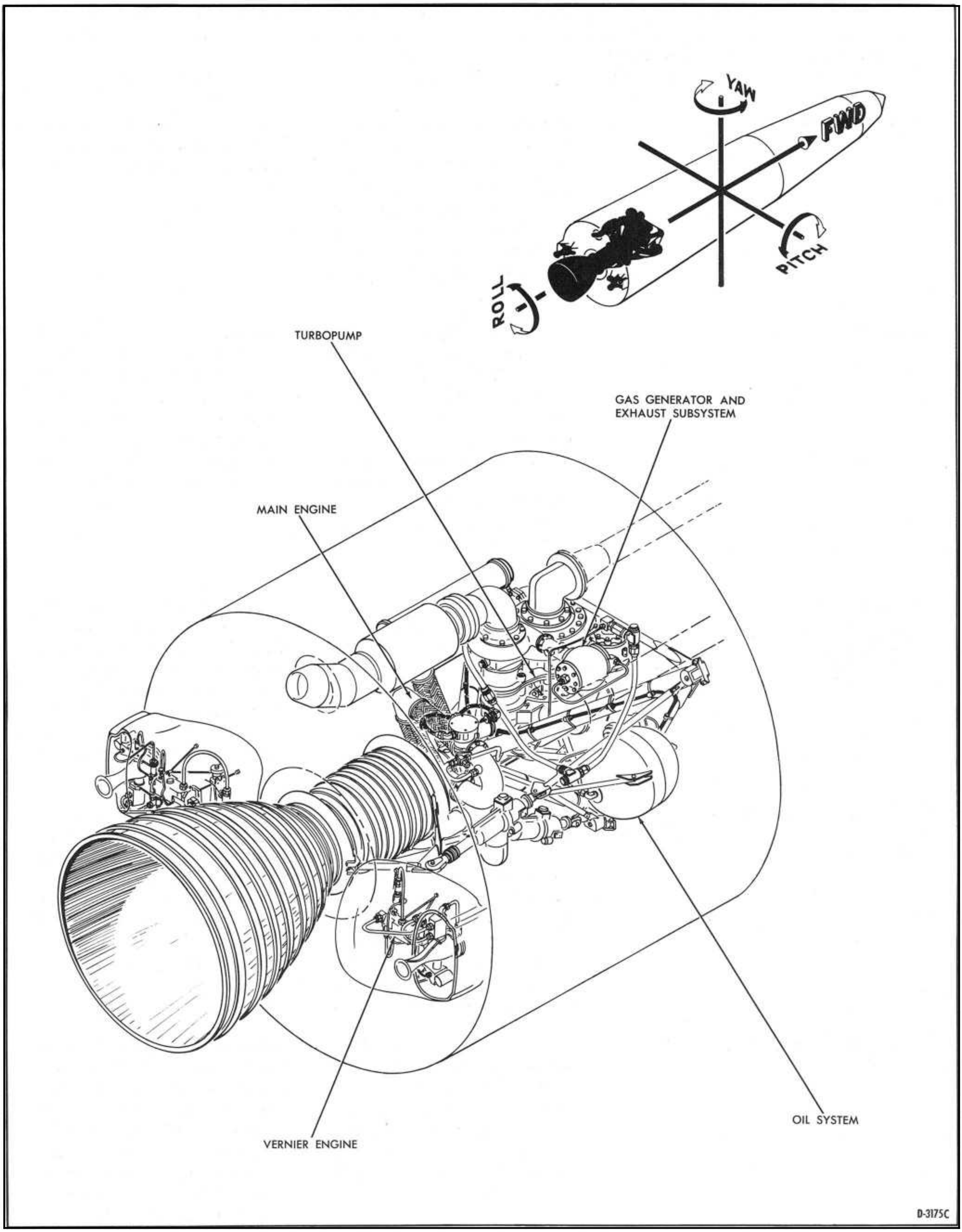


Figure 8-2. Rocket Engine Propulsion System

Table 8-1. Components and Subsystems of the Rocket Engine Propulsion System (Continued)

Equipment Name	*Index and Figure No.*	*Purpose*	*Characteristics*
Electrical subsystem		Provides means for remote operation and monitoring of electrical and electropneumatic components, for firing various igniters, and for heating those components that could be impaired by contact with, or passage of, liquid oxygen.	Consists of an engine relay box, a junction box, heaters, switches, connectors, thermostats, and harnesses.
Pneumatic subsystem		Adapts and regulates gaseous nitrogen supplied by ground or missile sources to actuate pneumatic and electropneumatic components, to purge certain components and plumbing, to provide a reference pressure to reference pressure regulator, and to pressurize oil tank, main propellant tanks, and propellant start tanks.	Composed of a pneumatic filter, pneumatic control assembly, four-way, pneumatic control valve, oil tank pressurizing valve, vernier engine oxidizer bleed valve, vernier propellant valve control, check valves, orifices and plumbing to engine components.
Start subsystem		Supplies fuel and liquid oxygen to vernier engines, gas generator subsystem, and ignition fuel valve during initiation of propulsion system operation, and again to vernier engines after main engine cutoff.	Composed of a fuel start tank, oxidizer start tank, ignition fuel valve, oxidizer regulator, start tank pressurizing and vent valves, check valves, orifices, and bootstrap lines between the start subsystem, main propellant subsystem, and vernier engines.
Main propellant subsystem		Pressurizes and delivers propellants from missile propellant tanks to main engine, vernier engines, and gas generator following start subsystem operation and during mainstage operation, and, in addition, replenishes fuel and oxidizer start tanks during mainstage operation.	Composed of a turbopump, a calibrated orifice in each main propellant duct, a main fuel valve, a main oxidizer valve, high-pressure propellant ducting, ignition fuel valve, fuel manifold, and fuel and oxidizer bootstrap lines.
Gas generator and exhaust subsystem	8-2	Provides hot gases to drive turbopump and utilizes exhausted hot gases to convert liquid oxygen to gaseous oxygen, through use of a heat exchanger, to provide inflight pressurization of main liquid oxygen tank.	Composed of a gas generator blade valve, spherical, dual-chamber combustor, rigid turbine inlet duct, blade valve position - indicating switch, purge-check valves and plumbing, two-stage turbine, turbine exhaust hood, heat exchanger, and turbine exhaust duct.

(Continued on Page 8-5)

Table 8-1. Components and Subsystems of the Rocket Engine Propulsion System (Continued)

Equipment Name	*Index and Figure No.*	*Purpose*	*Characteristics*
Oil system	8-2	Delivers oil under pressure from oil tank to turbopump gearbox to lubricate and cool turbopump gears and bearings during main engine operation.	The turbopump oil subsystem is a high-velocity, high-pressure, nonrecirculating system, composed of a pressurized oil tank, pressurizing valve, fill-flow restrictor valve, filter, manifold, internal oil nozzles, and plumbing.

8-6. GROUND SUPPORT EQUIPMENT.

8-7. The ground support equipment involved in maintenance and operation of the rocket engine propulsion system is described in (table 8-2).

Table 8-2. Rocket Engine Propulsion System GSE

Equipment Name	*Index and Figure No.*	*Purpose*	*Characteristics*
Launching control group	10, 8-3		Used at launch emplacement.
Malfunction panel	9, 8-3	Provides indication of area where malfunction occurs during countdown.	Consists of 30 malfunction lights, eight of which provide indications for rocket engine propulsion system.
Missile launching countdown group	7, 8-3		Used at launch emplacement.
Rocket Engine Control Interconnecting Box JEK-3/E47T-1	8, 8-3	Distributes a-c and d-c signals under control to rocket engine.	
Hydropneumatic systems controller	11, 8-3		Used at launch emplacement.
Pneumatic firing console	13, 8-3	Regulates and distributes gaseous nitrogen to missile and ground support equipment.	
Pneumatic purge and checkout console	12, 8-3	Regulates and distributes gaseous nitrogen to missile and ground support equipment for checkout and purge.	
Trailer-Mounted Ballistic Missile System Checkout Station TTU-92/M	1, 8-3 1, 8-4		Used at launch emplacement and RIM building.
Rocket Engine Checkout Control-Monitor SWK-4/E47T-1	4, 8-3 4, 8-4	Controls, monitors, and simulates rocket engine propulsion system and its components for checkout and troubleshooting.	Can be used to manually or automatically monitor rocket engine propulsion system and its components.
Pneumatic Flow and Pressure Panel GMK-1/E47T-1	3, 8-3 3, 8-4	Regulates an external source of gaseous nitrogen for checkout of rocket engine propulsion system components.	Used in checking engine liquid oxygen clean systems.

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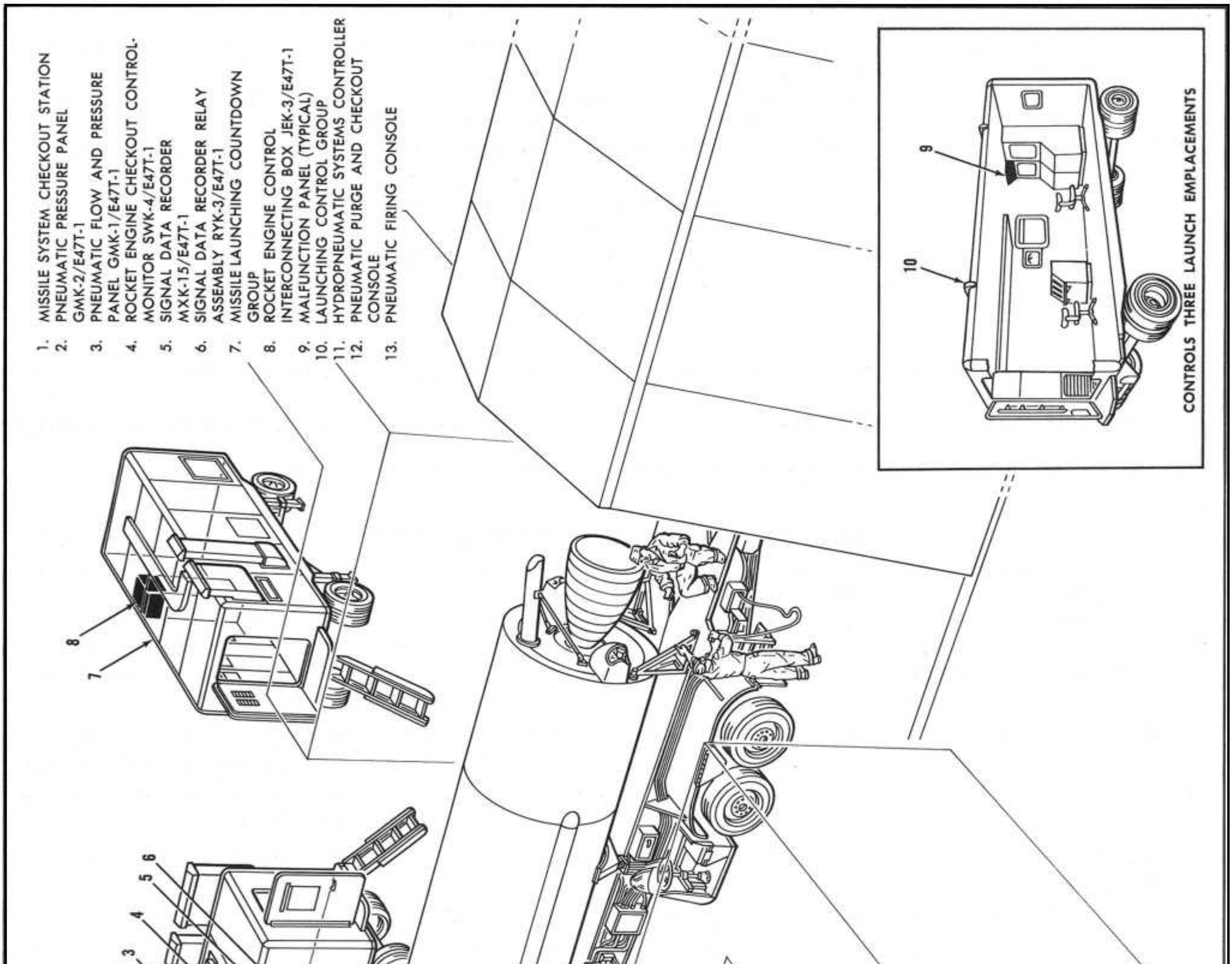


Figure 8-3. Rocket Engine Propulsion System Checkout and Launch Equipment — Launch Emplacement

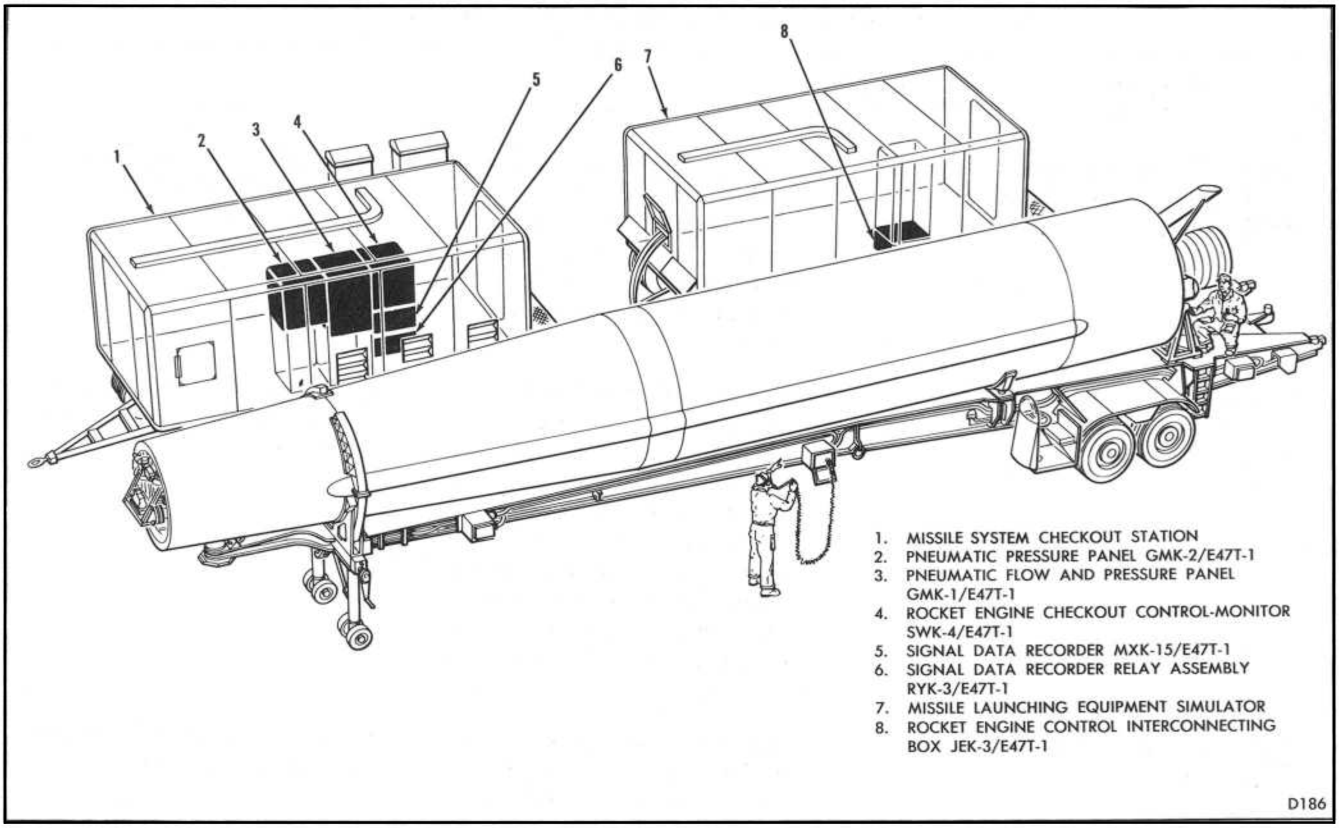


Figure 8-4. Rocket Engine Propulsion System Checkout Equipment — RIM Building

Table 8-2. Rocket Engine Propulsion System GSE (Continued)

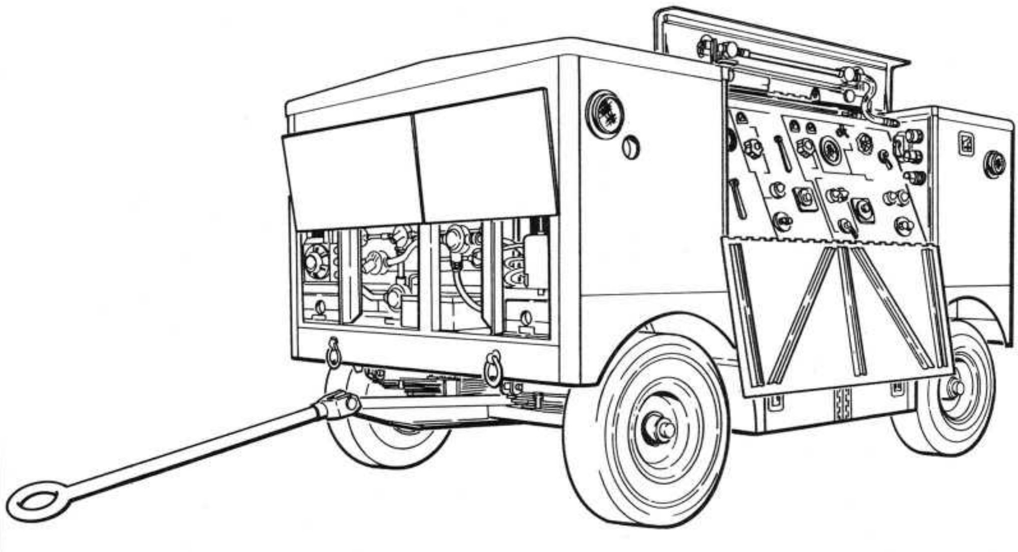
Equipment Name	*Index and Figure No.*	*Purpose*	*Characteristics*
Pneumatic Pressure Panel GMK-2/E47T-1	2, 8-3 2, 8-4	Regulates an external source of gaseous nitrogen for checkout of rocket engine propulsion system components.	Used in checking engine liquid oxygen clean and fuel subsystems.
Signal Data Recorder MXK-15/E47T-1	5, 8-3 5, 8-4	Records time sequence and duration of events as they occur in operation of rocket engine.	Fifty separate channels of information can be recorded simultaneously.
Signal Data Recorder Relay Assembly RYK-3/E47T-1	6, 8-3 6, 8-4	Controls electrical power to chart drive mechanism and stylus circuitry of signal data recorder.	There are no controls on face of this panel.
Missile Launching equipment simulator	7, 8-4		Used at RIM building.
Rocket Engine Control Interconnecting Box JEK-3/E47T-1	8, 8-4	Distributes a-c and d-c signals under control to rocket engine.	

(Continued on Page 8-8)

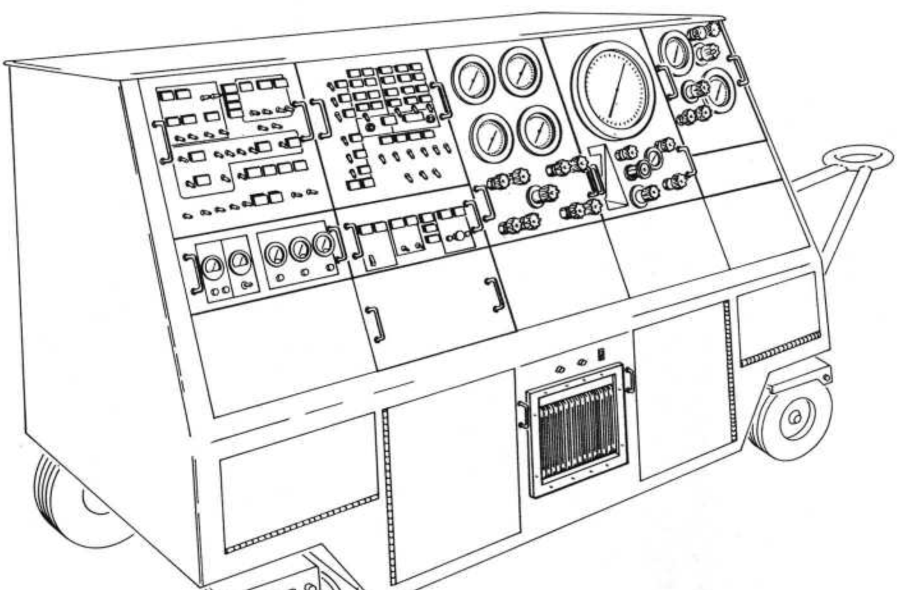
Table 8-2. Rocket Engine Propulsion System GSE (Continued)

Equipment Name	Index and Figure No.	Purpose	Characteristics
Rocket Engine Lubricating-Purging Service Unit AF/M46M-1	8-5	Stores, transports, conditions, and delivers fluids to rocket engine propulsion system for flushing, purging, lubricating, and preserving engine for storage or preparing it for operation.	Four-wheel, towable unit for use at launch emplacement and RIM building.
Rocket Engine Electrical-Pneumatic Test Stand AF/E47T-1	8-5	Contains electrical and pneumatic panels, pneumatic valving and plumbing, electrical circuitry and instrumentation, and all necessary connections, hoses, and cabling for performing complete and detailed checkouts of engine subsystems and components when engine is not installed in missile.	Four-wheel, towable unit for use at launch emplacement and RIM building.
Airframe Engine Section Truck ETU-15/E	8-6	Supporting engine and accessories section of missile airframe when removed from missile.	Caster mounted and towable. Used at RIM building.
Hoisting Beam HLU - 16/E	8-6	Hoisting engine and accessories section of missile airframe.	Incorporates mechanism for rolling engine installed in engine and accessories section and rotating it from horizontal to vertical positions. Used at RIM building.
Rocket Engine Truck ETU-16/E	8-6	Supporting engine and rocket engine handling cradle in a stabilized vertical position during installation or removal from missile engine and accessories section.	Caster mounted mobile support and used at RIM building.
Rocket Engine Lifting Sling HLU-10/E	8-7	Connecting engine and rocket engine handling cradle to an overhead hoist for lifting.	Used at RIM building.
Rocket Engine Handling Cradle ETU-17/E	8-7	Handling and supporting engine when engine is not installed in missile.	Incorporates mechanism for rotating rocket engine from horizontal to vertical position when supported by rocket engine lifting sling. Used at RIM building.
Transportation Trailer Model 1210	8-7	Transporting engine in horizontal position between points of destination in squadron area.	Unit is steerable and towable, with pneumatic tires. Used at RIM building.

(Continued on Page 8-12)



ROCKET ENGINE LUBRICATING-PURGING
SERVICE UNIT AF/M46M-1



ROCKET ENGINE ELECTRICAL-PNEUMATIC
TEST STAND AF/E47T-1

D-22470A

Figure 8-5. Servicing and Test Equipment

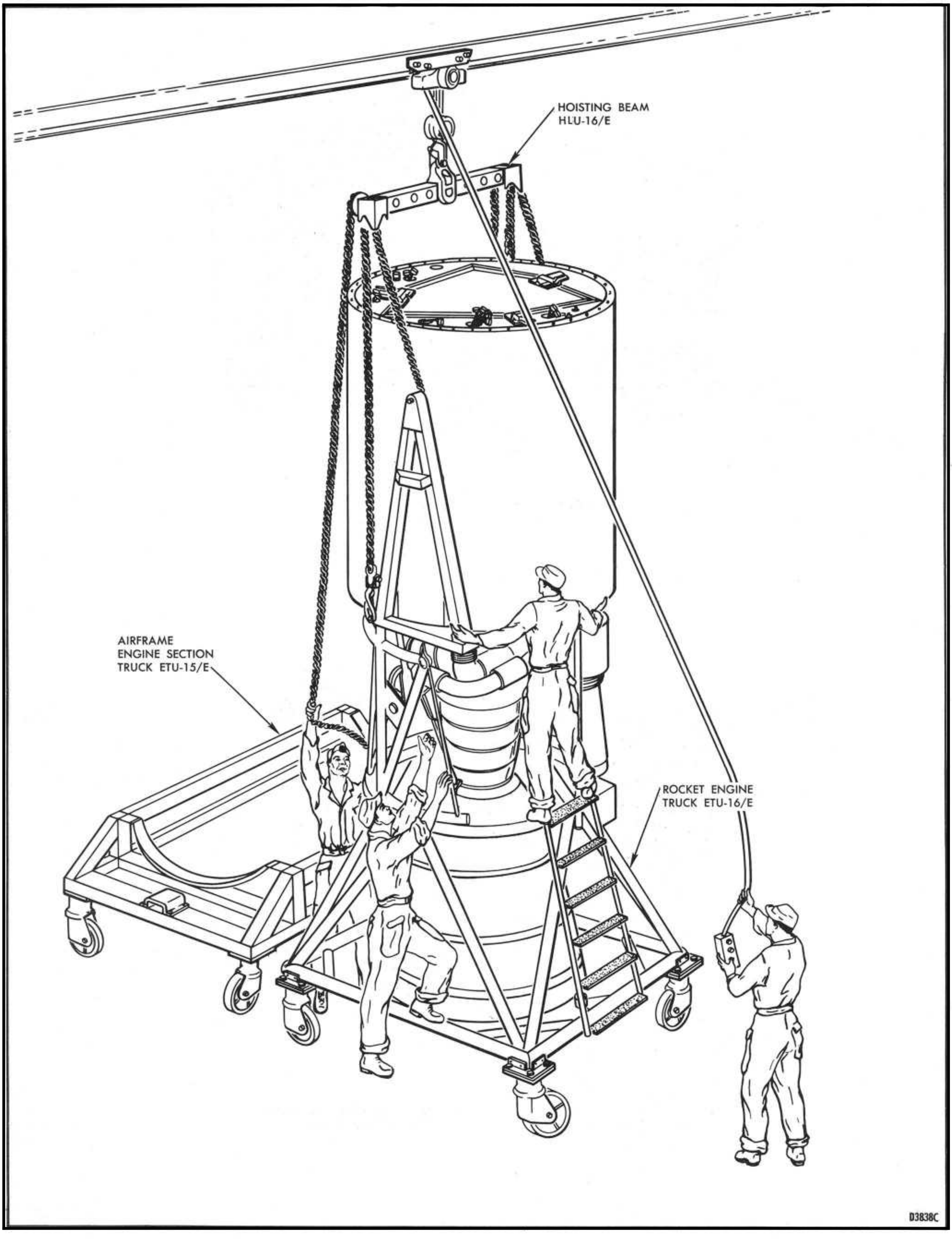


Figure 8-6. Engine to Engine and Accessories Section Mating Equipment

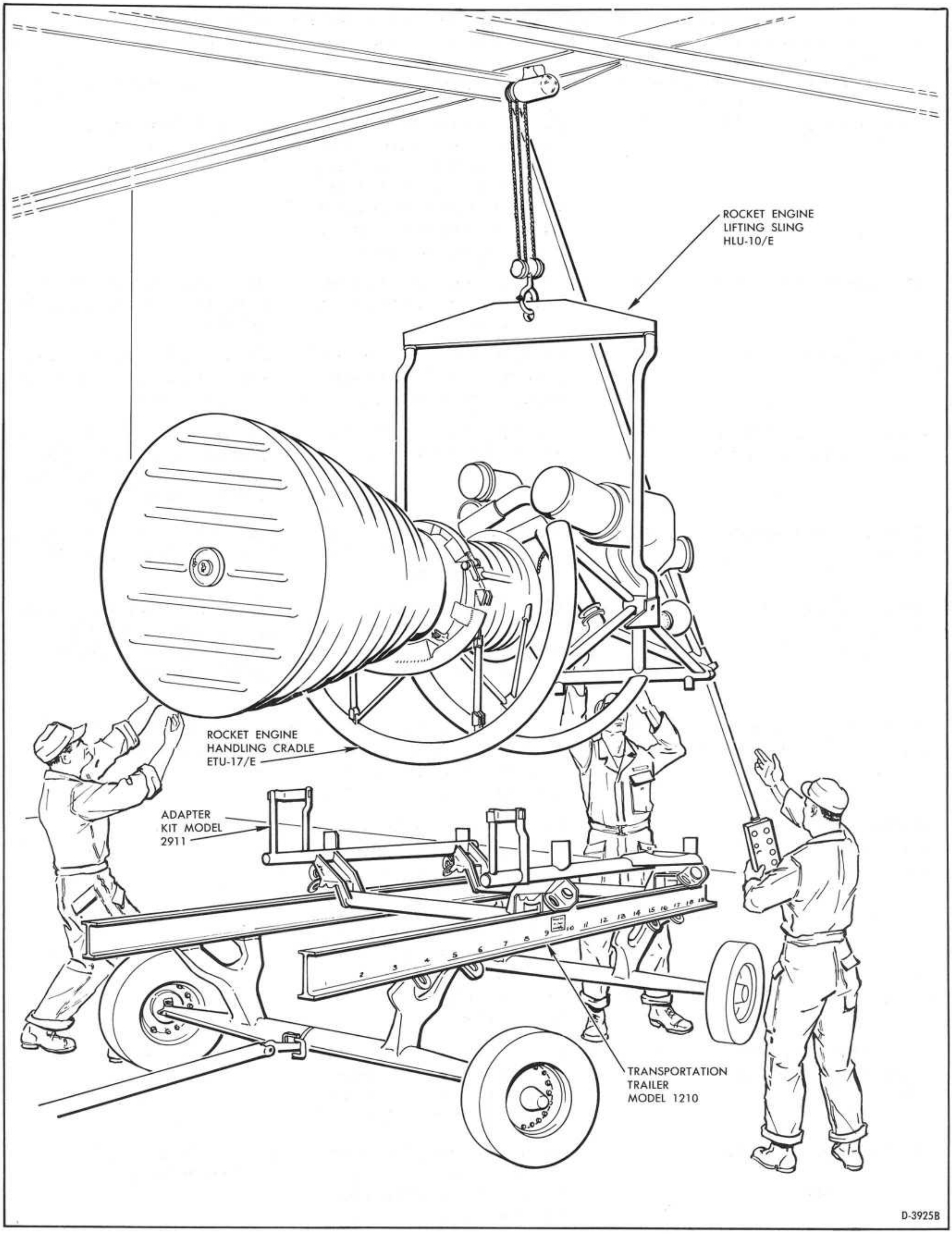


Figure 8-7. Engine Lifting and Transporting Equipment

Table 8-2. Rocket Engine Propulsion System GSE (Continued)

Equipment Name	Index and Figure No.	Purpose	Characteristics
Adapter Kit Model 2911	8-7	Moving engine onto or off transportation trailer. Provides a means of adapting rocket engine cradle to transportation trailer. Provides a means of mounting vernier engines during transport.	Used at RIM building.
Mobiltainer Model 2910	8-8	Protects main and vernier engines during transportation and storage.	Four-wheel, towable, environmental container. Used at RIM building.
Workstand MMU-2/E	8-8	Provides rigid support for main engine during prolonged maintenance operations.	Mates with transportation trailer and mobiltainer. Used at RIM building.
Vernier Rocket Engine Lifting Sling HLU-11/E	8-9	Provides means of hoisting and moving vernier engine.	Consists of a 3-inch ring, two webbing straps, and quick-release snap type fasteners. Used at RIM building.
Vernier Engine Maintenance Stand	8-9	Secures and supports vernier engine in horizontal position during maintenance.	Three-wheel, mobile stand. Used at RIM building only.
Pneumatic Flow Tester TTU-46/E	8-10	Measures and monitors vent and drain port leakage rates during detailed leakage tests of engine pneumatic subsystems.	Can be hand carried. Consists of calibrated tubes and meters. Used at launch emplacement and RIM building.
Rocket Engine Checkout Service Kit KMU-15/E	8-10	Provides items necessary to seal engine openings from atmosphere during leak and functional checks.	Used at launch emplacement and RIM building.
Rocket Engine Maintenance Service Kit KMU-16/E	8-10	Provides items necessary to seal engine openings from atmosphere during leak and functional checks. It also provides all special hand tools needed for component replacement and adjustment, and for performing functional tests when engine is removed from missile.	Used at RIM building.
Propellant Drain Hose Assembly Kit KMK-20/E26A	8-11	Provides necessary hoses and funnel for draining propellants from engine when missile is in vertical position.	Used at launch emplacement.
Quick-disconnect test kit	8-11	Provides necessary liquid oxygen clean adapters for connecting pneumatic hoses during checkout.	Used at launch emplacement and RIM building.

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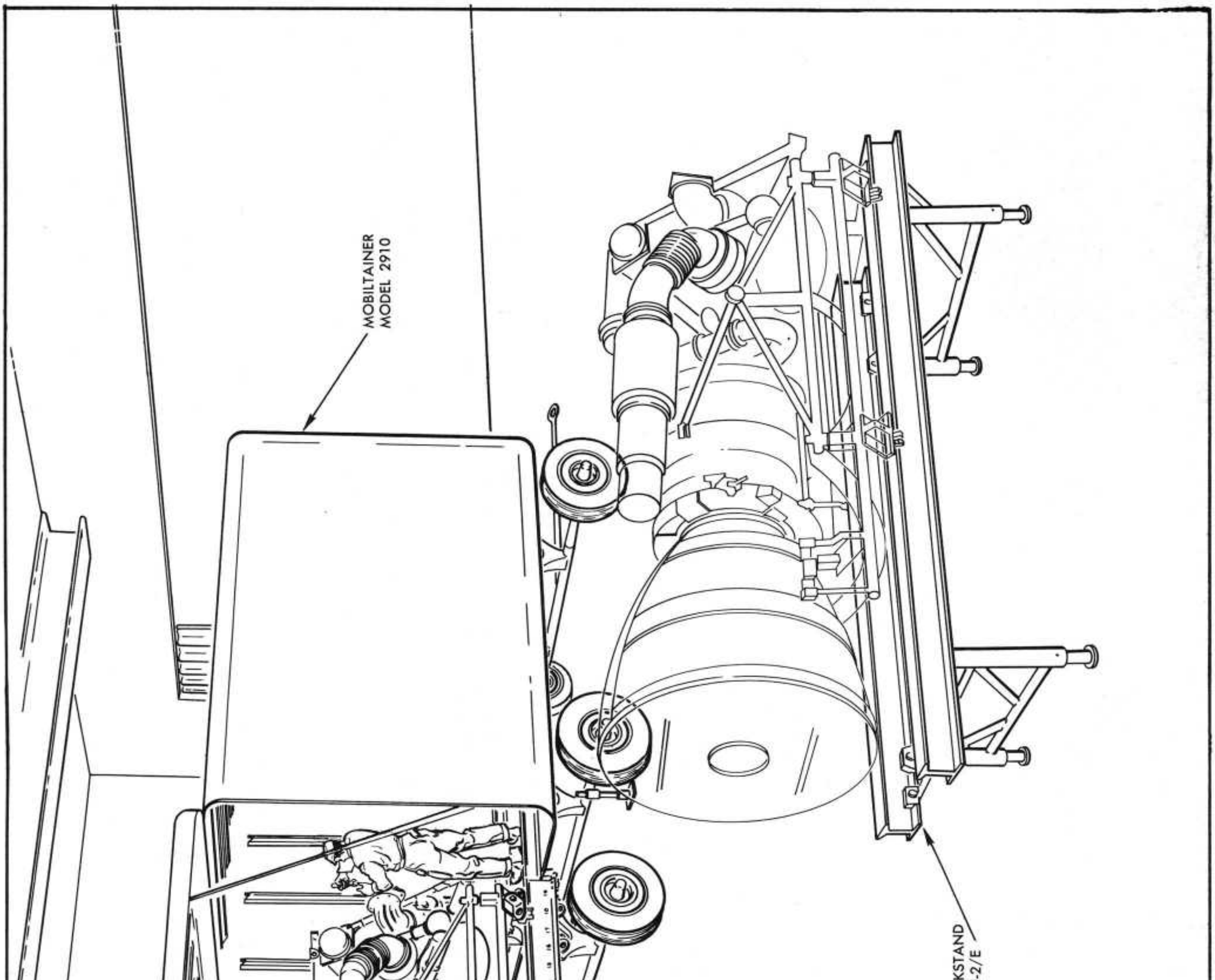


Figure 8-8. Rocket Engine Propulsion System Mobiltainer

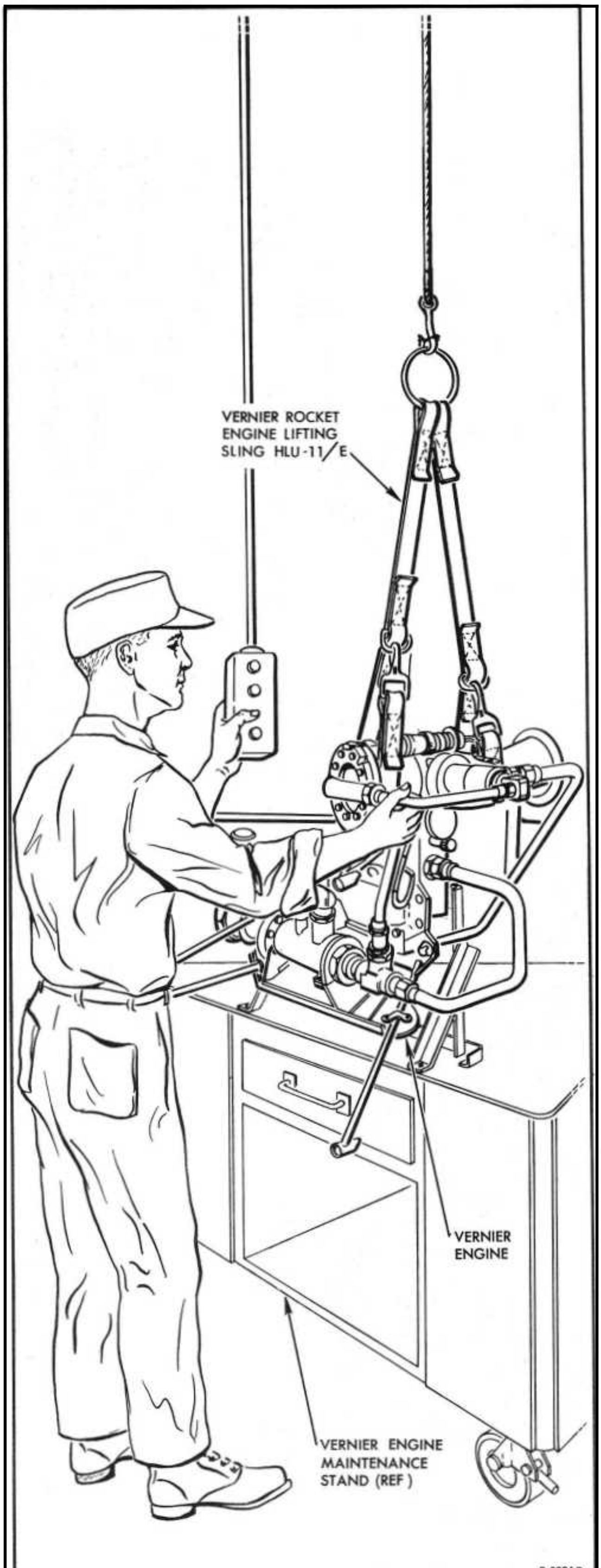


Figure 8-9. Vernier Engine Equipment

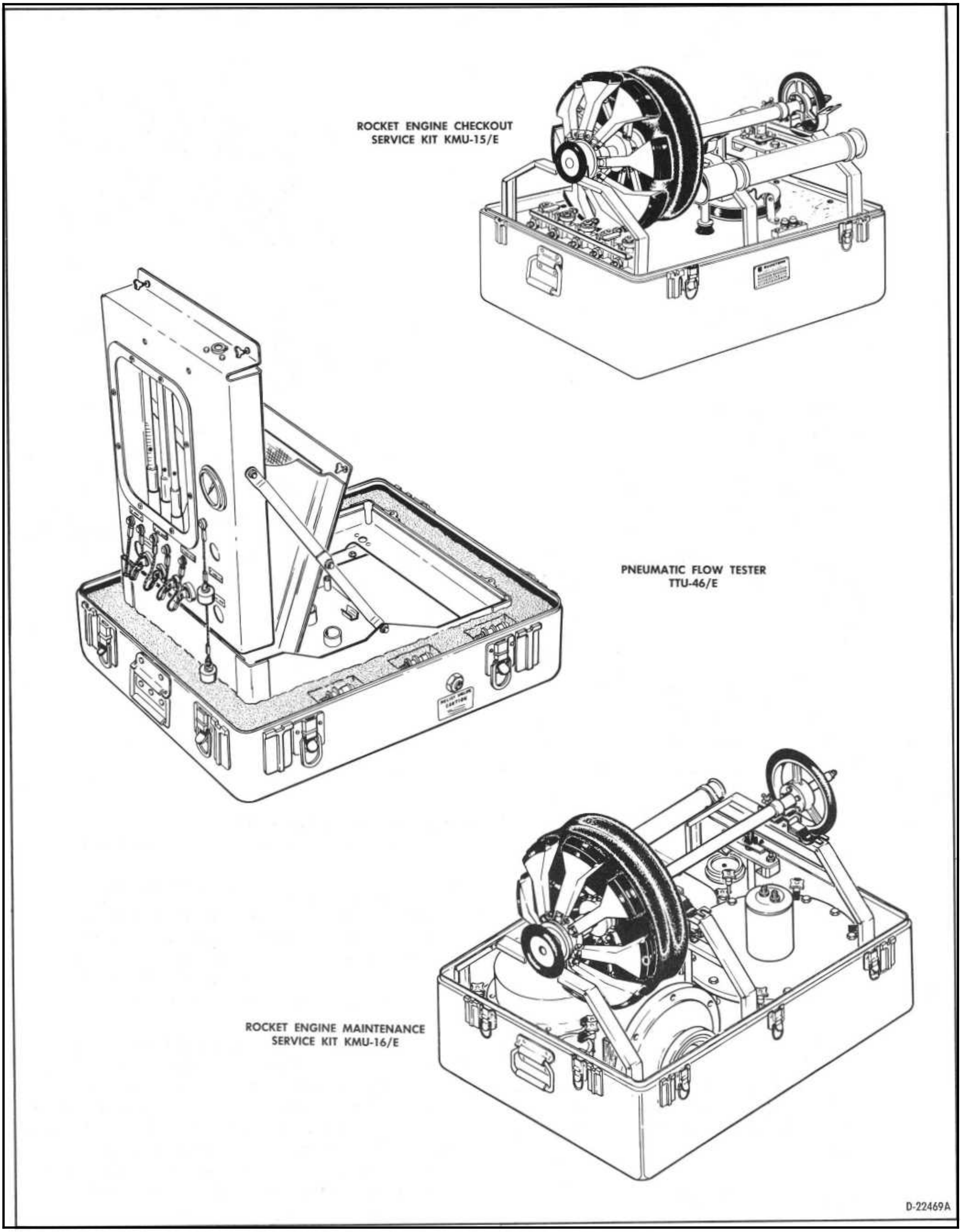


Figure 8-10. Special Test Equipment

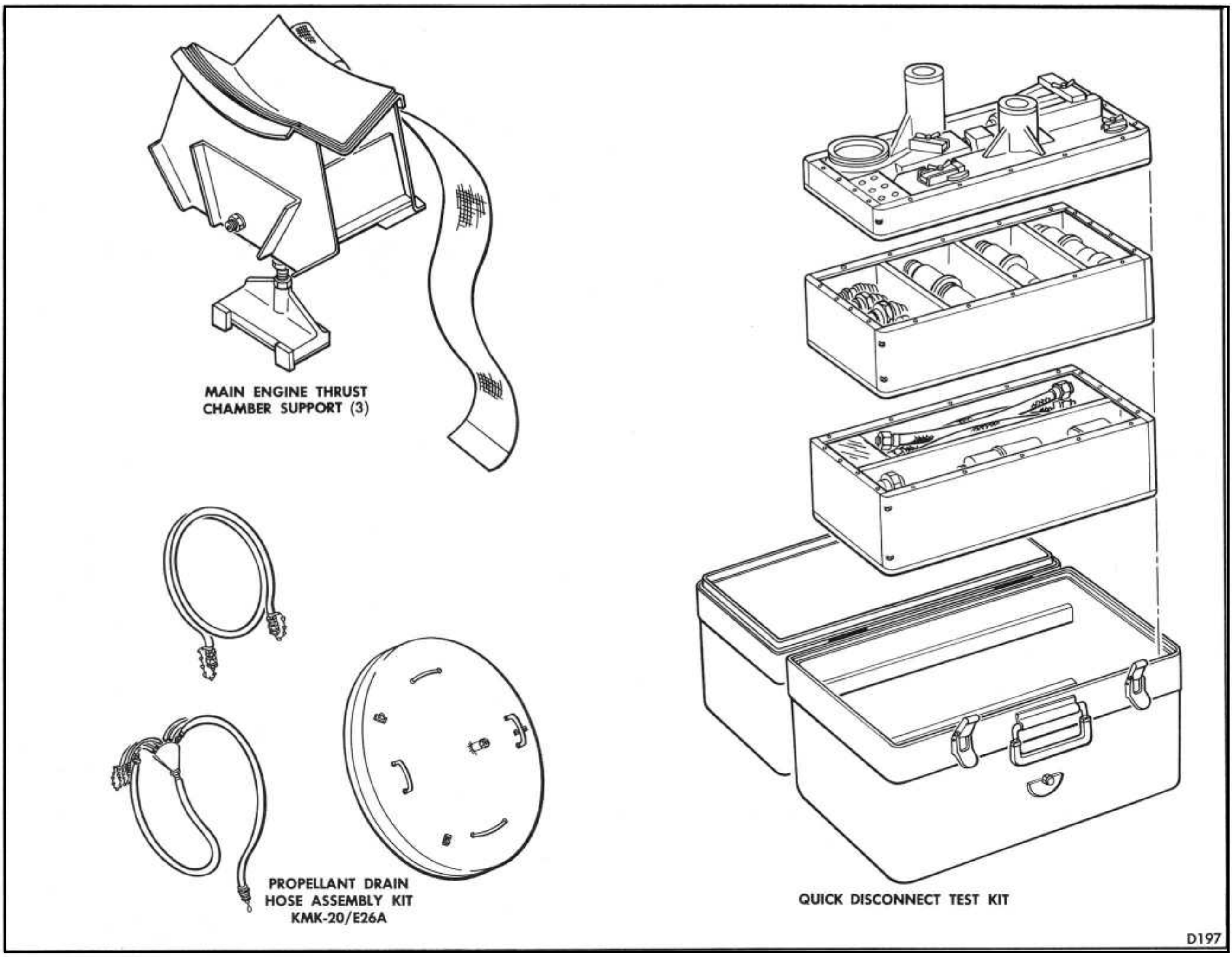


Figure 8-11. Service and Maintenance Equipment

Table 8-2. Rocket Engine Propulsion System GSE (Continued)

Equipment Name	*Index and Figure No.*	*Purpose*	*Characteristics*
Main engine thrust chamber support	8-11	Supports main engine thrust chamber horizontally during service, repair, storage, and transportation.	Consists of three supports installed between aft missile airframe bulkhead and main engine thrust chamber throat.

8-8. OPERATION.

8-9. The following paragraphs describe the different environments the rocket engine propulsion system goes through from missile receipt at the RIM building through launch.

8-10. RIM BUILDING PROCEDURES.

8-11. After arrival from the airstrip, the missile is positioned in the missile maintenance area of the RIM building (figure 8-12). A maintenance team performs a comprehensive inspection of the propulsion system for in-transit damage, corrosion, proper installation of covers and closures, and desiccants. After inspection and necessary repairs, the propulsion system is prepared for checkout. If servicing is required before checkout procedures are initiated, a lubricating-purging service unit (figure 8-5) is connected to the engine and the propulsion system is completely purged and lubricated.

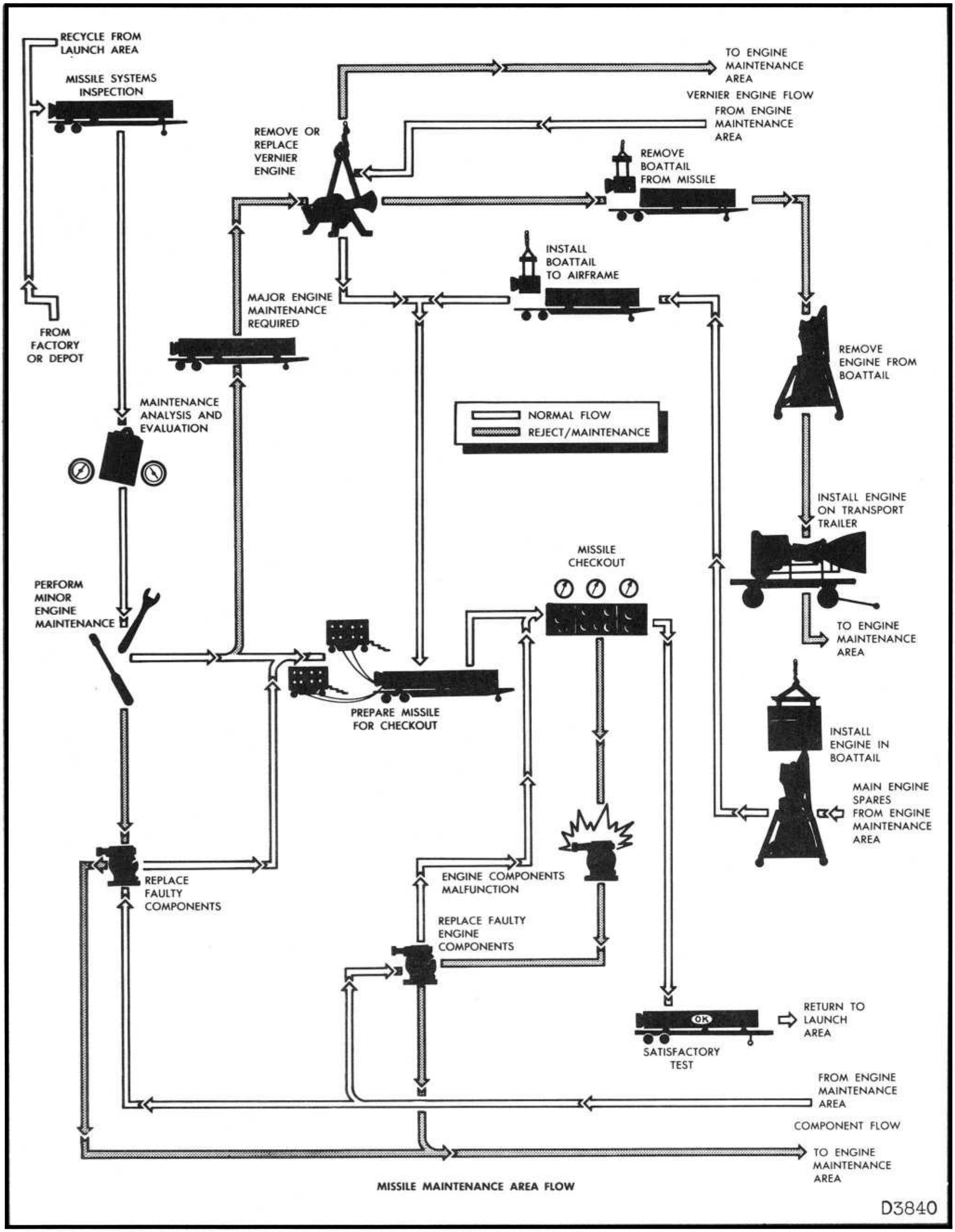


Figure 8-12. Missile Maintenance Area Operations

8-12. Following these inspection and servicing activities, a checkout team connects the missile and the missile checkout station, and the missile launching simulator (figure 8-4). Next the consoles, circuitry, and pressure gages of the checkout equipment are checked. After the checkout equipment has been certified, the engine logbook and AFTO cards are inspected and any hardware changes affecting the main and vernier engines are noted. All associated equipment is now ready to be used to check out the propulsion system.

8-13. The first checkouts performed on the propulsion system consist of leak and functional tests. Leak checks are performed audibly and with leak test fluid to discover possible pneumatic leaks within the subsystems. Functional checks are then performed to verify the operation of components. The next checkout is electromechanical, and tests the engine components individually or in sequence of operation.

8-14. After leak tests, functional tests, and electromechanical checkout have qualified the individual systems and components, a checkout of the integrated propulsion system is made. Following integrated checkout, the missile is prepared for shipment to the launch emplacement.

8-15. SPARE ENGINES. Spare rocket engines are shipped in mobiltainers (figure 8-8) to the missile maintenance area (figure 8-12). Here the mobiltainer is inspected and then removed to the engine maintenance area (figure 8-13) where the engine is unloaded and inspected.

8-16. Checkout acceptance of the main engine is performed in the engine shop. The servicing and checkout procedures are similar to those outlined in paragraphs 8-11 through 8-13, except that the electrical and pneumatic test stand (figure 8-5) instead of checkout trailers is used for checkout. After the engine checkout is completed, the engine is assigned for immediate service or replaced in the mobiltainer for spare storage.

8-17. Checkout acceptance is performed on individual vernier engines (figure 8-9) in conjunction with the main engine to provide a comprehensive checkout. Upon completion of checkout, the vernier engines are either returned with the main engine to the mobiltainer for storage or installed in separate containers.

8-18. When an engine is moved into the handling area of the missile maintenance bay for installation in the engine and accessories section (figure 8-6), it is first placed in position on the missile. Next all bolts, lines, harnesses, and receptacles are connected. After the main engine and engine and accessories section have been installed on the missile, the vernier engines are installed on the aft bulkhead of the engine and accessories section.

8-19. LAUNCH EMPLACEMENT PROCEDURES.

8-20. Upon arrival at the launch emplacement (figure 8-14) and prior to the mating of the missile to the erecting-launching mount, a general receiving inspection is conducted. If all conditions are satisfactory, the missile is prepared for mating to the erecting-launching mount.

8-21. After the missile has been mated to the erecting-launching mount, ground support equipment is connected (figure 8-3) and the lubricating-purging service unit (figure 8-5) is used to service the rocket engine propulsion system. Next complete checkout procedures are performed similar to those conducted at the RIM building. If a minor malfunction is detected, an analysis is made, and the malfunction is corrected. But if a detected malfunction requires additional analysis or specialized maintenance, tests are discontinued.

8-22. All replacement parts required at the launch emplacement must be obtained from the storage area at the RIM building, and the rejected parts must be routed to the same area. If a malfunction involves major change or disassembly of propulsion system components, the missile is taken out of checkout status and returned to the RIM building.

8-23. Upon satisfactory completion of all the missile systems checkouts, ready condition is established. In ready condition, the missile systems are constantly monitored by ground support equipment. If daily or periodic inspections of the missile reveal any unsatisfactory condition, an immediate analysis is performed. Unsatisfactory conditions that could affect the operation of the equipment are cause for the missile to be placed in a maintenance status. When the condition is corrected, the missile is again returned to the ready status.

8-24. A wet exercise is the final nondestructive operation of the missile in the weapons system. In the wet exercise, all conditions of actual launch operation are either present or simulated. The wet exercise operation is the same as an actual launch except the rocket engines are not activated or fired in phase V. Phase I and phase V of the countdown sequence are the only phases of the wet exercise when the rocket engine propulsion system is directly affected. During the automatic sequencing in these two phases, the operation of the engine components results in response signals being relayed to different panels within the GSE trailers. Per-

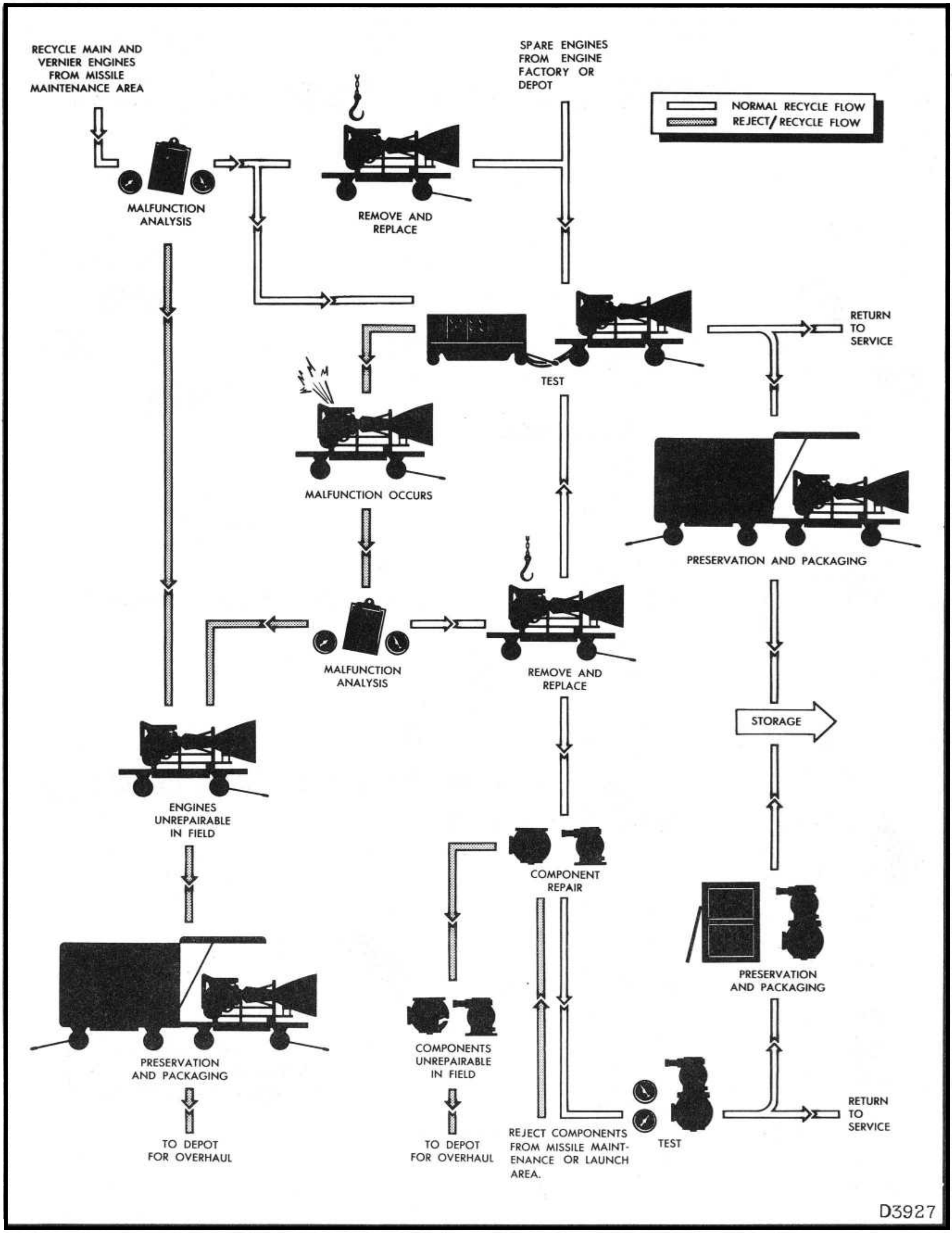


Figure 8-13. Engine Maintenance Area Operations

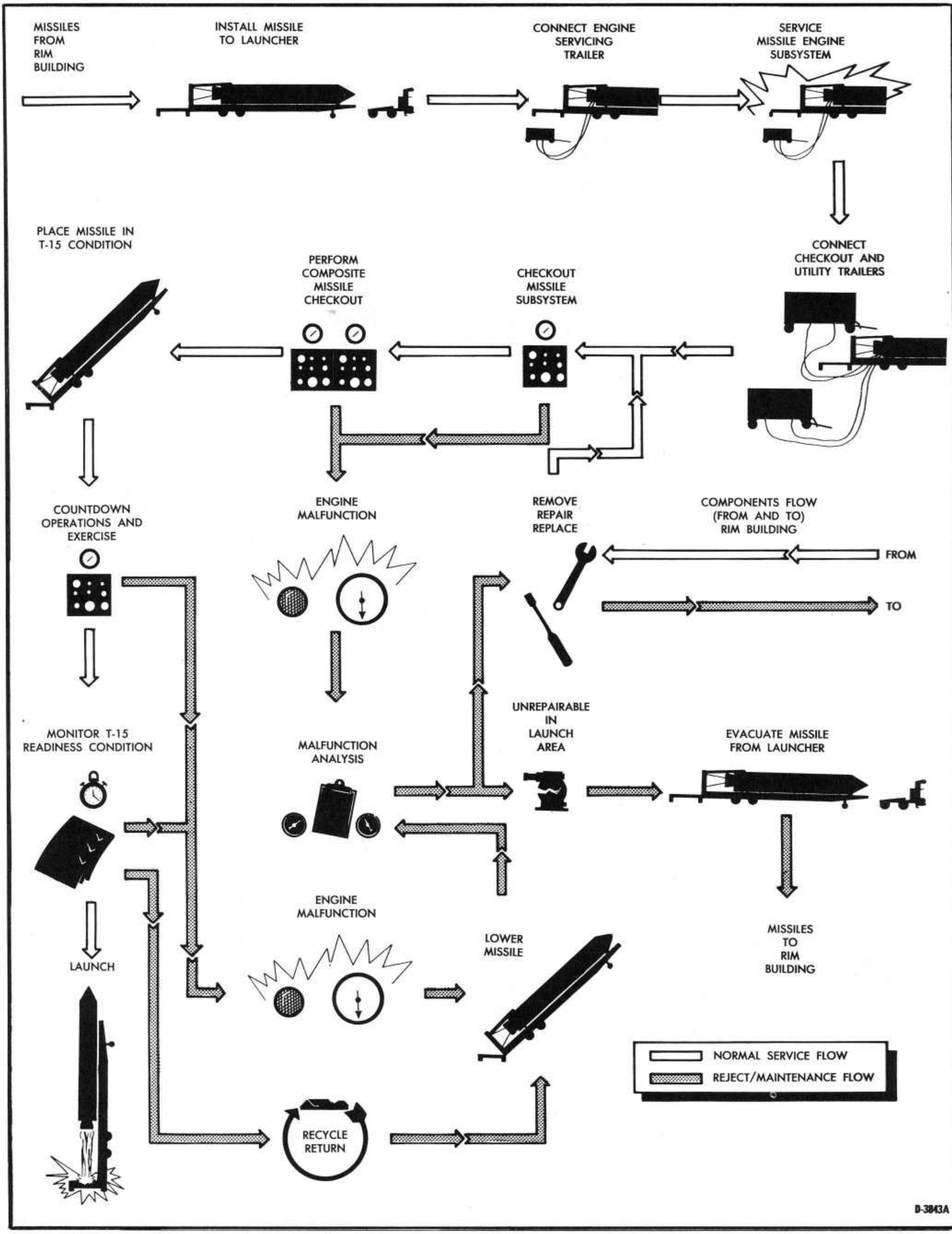


Figure 8-14. Launch Operations

sonnel operating and monitoring the panels observe the signals to check proper propulsion system component operation.

8-25. Any malfunction occurring during the wet exercise is immediately detected and either a technical or operational hold is imposed on the countdown. With the hold in effect, specially trained personnel use the checkout capabilities of the consoles and troubleshooting data to isolate and analyze the cause of malfunction. Detected conditions that can be corrected at once are corrected within hold time limits. If the malfunctions cannot be corrected within the wet exercise countdown hold limits, the exercise is aborted and the missile is removed from countdown and placed in maintenance status. If no malfunction occurs, or if a malfunction is corrected within hold limitations, the countdown is continued to simulate missile lift-off. Following a successful wet exercise, the signal data recorder records are removed and examined by the engine maintenance personnel. At this time the activities of the missile systems components are compared to prescribed operating standards. If discrepancies are indicated on the records, a maintenance analysis is made. If no unsatisfactory conditions are determined from the examination of the signal data recorder information, the missile is returned to ready status.

8-26. LAUNCH COUNTDOWN. The ultimate activity of the weapon system is countdown to launch. This operation consists of five phases of automatically sequenced operations. During countdown, (paragraphs 1-55 through 1-67), phase I and phase V are the phases which directly affect the rocket engine propulsion system.

SECTION IX

FLIGHT CONTROL SYSTEM

9-1. PURPOSE.

9-2. The purpose of the airborne flight control system is to control the thrust direction of the missile rocket engines during powered flight so as to maintain the missile in a predetermined target trajectory. In addition, this system at the completion of powered flight sequences the separation of the re-entry vehicle at the prescribed point in space to strike the target. Other elements of the flight control system consist of specialized ground support equipment, such as the flight controller test stand (figure 9-1) which insure operational reliability of the system.

9-3. DESCRIPTION.
(See figure 9-2.)

9-4. AIRBORNE EQUIPMENT.

9-5. The airborne system is essentially a programmed, three-axis, autopilot, servo system made up of coordinated electrical, electronic, and hydraulic components.

9-6. The flight controller is the principal component of the system and contains target selection circuitry, servo amplifiers, a programming film strip timer, control relays, hermetically sealed integrating (HIG) gyros that sense altitude errors. Selection of target is made by the launching control group by energizing relay and control circuits in the target selection section of the controller (sheet 1 of 6, figure 1-15). After the missile is launched, the programming film strip timer, at specific time intervals, energizes relays which in turn complete control circuits that supply varying currents to the control fields of the roll and pitch HIG gyros. This causes a proportional displacement of the gyro signal generator. When the signal generator is displaced from its null position, an output signal (error signal) is sent to the servo amplifiers controlling the missile engine actuators, this deflects the engines and alters the path of the missile.

9-7. Response of the missile to the HIG gyro error signal causes an angular rate of change which is converted to an error signal by the rate gyros located in the center body section of the missile. The rate gyro signal is summed with the HIG gyro output signal to prevent overcorrection and subsequent oscillatory hunting of the system for its null position.

9-8. In addition to the programming function, the HIG gyros in the flight controller also sense attitude deviations and signals them throughout the missile flight. A change of the missile attitude in any of its three flight axes is sensed by the appropriate yaw, pitch, or roll HIG gyro. This movement causes precession of the gyro and a corresponding displacement of the gyro signal generator. The output signal from the signal generator is fed to the servo amplifier controlling the missile engine actuators which return the missile to its correct position. The rate gyros perform the same as in programmed flight, preventing overcorrection and oscillatory hunting of the system for its null position.

9-9. After initial portion of programmed flight, which places the missile in a specified azimuth and trajectory, the guidance command relay activates guidance command so that final trajectory and azimuth information can be supplied by the guidance system to the flight control system. The guidance system provides a comparison of the predetermined missile position and velocity with the actual missile position and velocity.

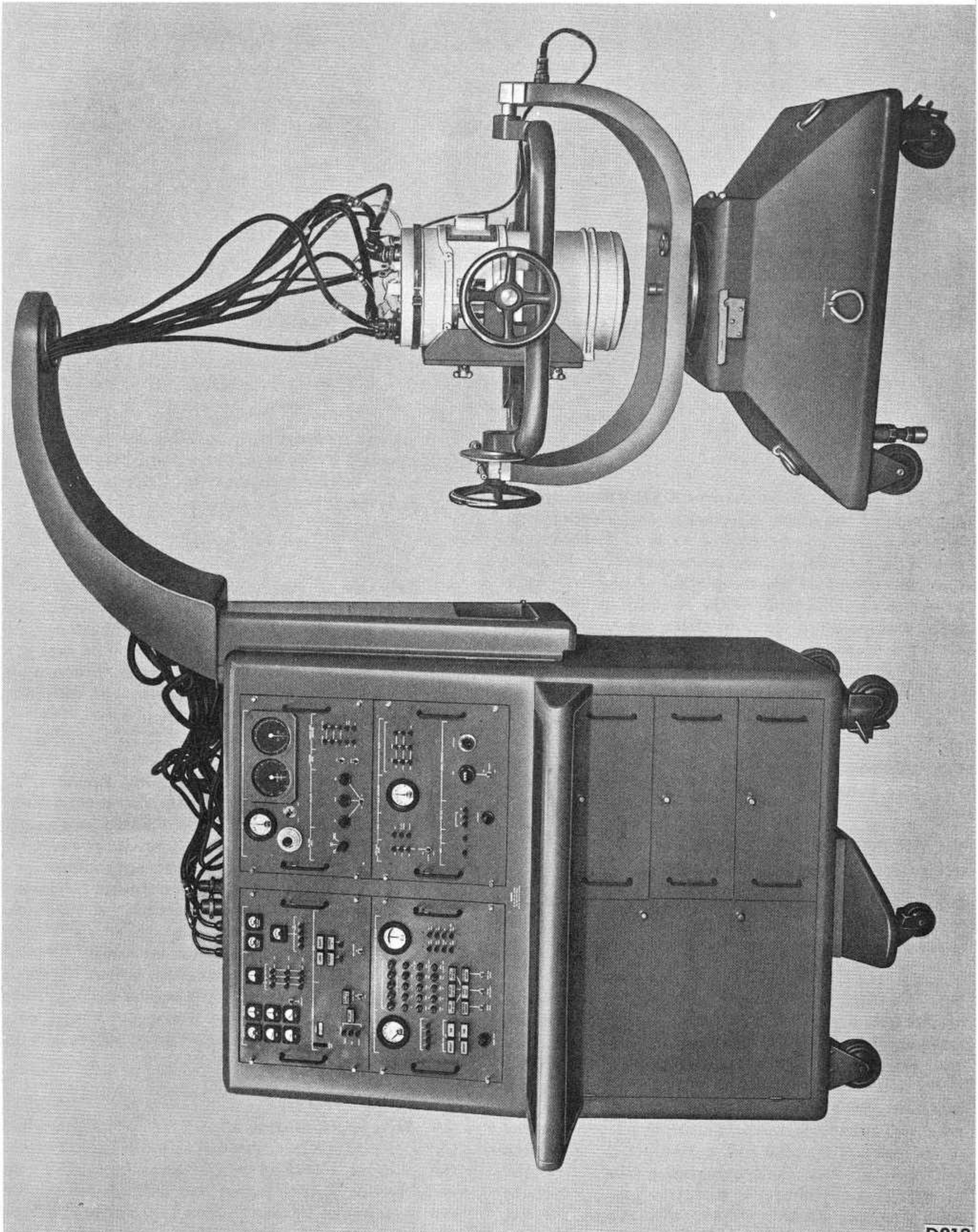


Figure 9-1. Flight Controller — Test Environment

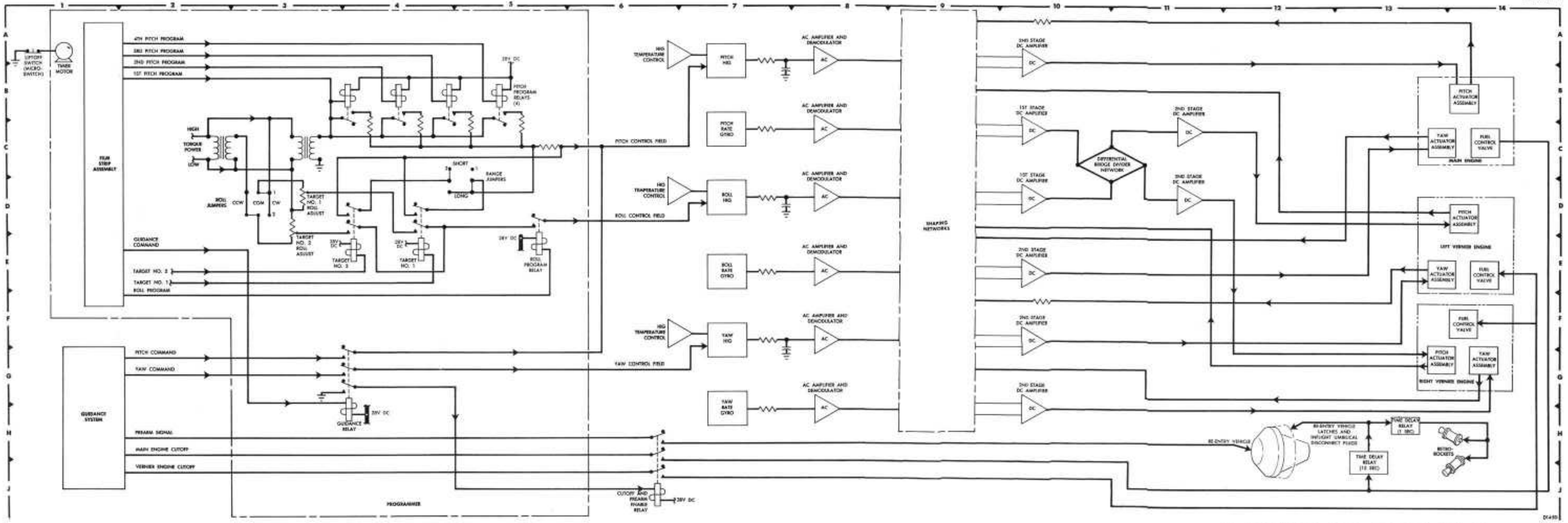


Figure 9-2. Flight Control System Engine Actuator Control — Data Flow Diagram

The guidance system, if required, corrects the missile position to the predetermined position (correct target trajectory). When this has been accomplished the guidance system initiates engine cutoff and the re-entry vehicle separation sequence which results in separation of the re-entry vehicle (warhead) from the missile main body. Table 9-1 describes the airborne components of the flight control system.

Table 9-1. Flight Control System Airborne Components

Equipment Name	*Figure Reference*	*Purpose*	*Characteristics*
Flight controller	E, 9-3	Provides programmed inflight commands for positioning rocket engines to place missile into a specific trajectory. Missile attitude deviations are also sensed by unit which provides correction commands to reposition rocket engines to maintain proper trajectory.	Hermetically sealed unit containing following subassemblies: Programmer HIG gyros, a-c amplifier-demodulators, shaping networks, d-c amplifiers, temperature control assembly, power supply, and target selector.
Motor-generator	K, 9-3	Converts 28V missile battery power to 400-cycle a-c power for missile systems operation.	Hermetically sealed unit containing a 115V a-c, 3-phase, 400-cycle generator driven by a 28V d-c motor.
Missile batteries	J, 9-3	Provide prime source of electrical power for missile during flight.	Two batteries are mounted on guidance section lower equipment door. Each battery contains 25 nickel-cadmium cells, output voltage is 28V dc.
A-c distribution box	F, 9-2	Provides distribution and control of a-c power to missile electrical system.	Hermetically sealed unit containing relays and terminal panels. Unit is mounted in upper portion of guidance section.
D-c distribution box	I, 9-3	Provides distribution and limited control of d-c power to missile electrical system.	Unsealed unit containing relays and terminal panels. Unit is mounted in lower portion of guidance section.
Sequential timer (separation) distribution box	D, 9-3	Provides timing sequence signals for re-entry vehicle separation.	Unsealed unit containing relays and terminal panels. Unit is mounted in upper portion of guidance section.
Re-entry vehicle latches	G, 9-3	To release re-entry vehicle from missile body at time of separation.	Small electrically ignited squibs mounted in the three latch cylinders are detonated at time of separation to create pressure within latch release cylinders thus forcing latches to open.

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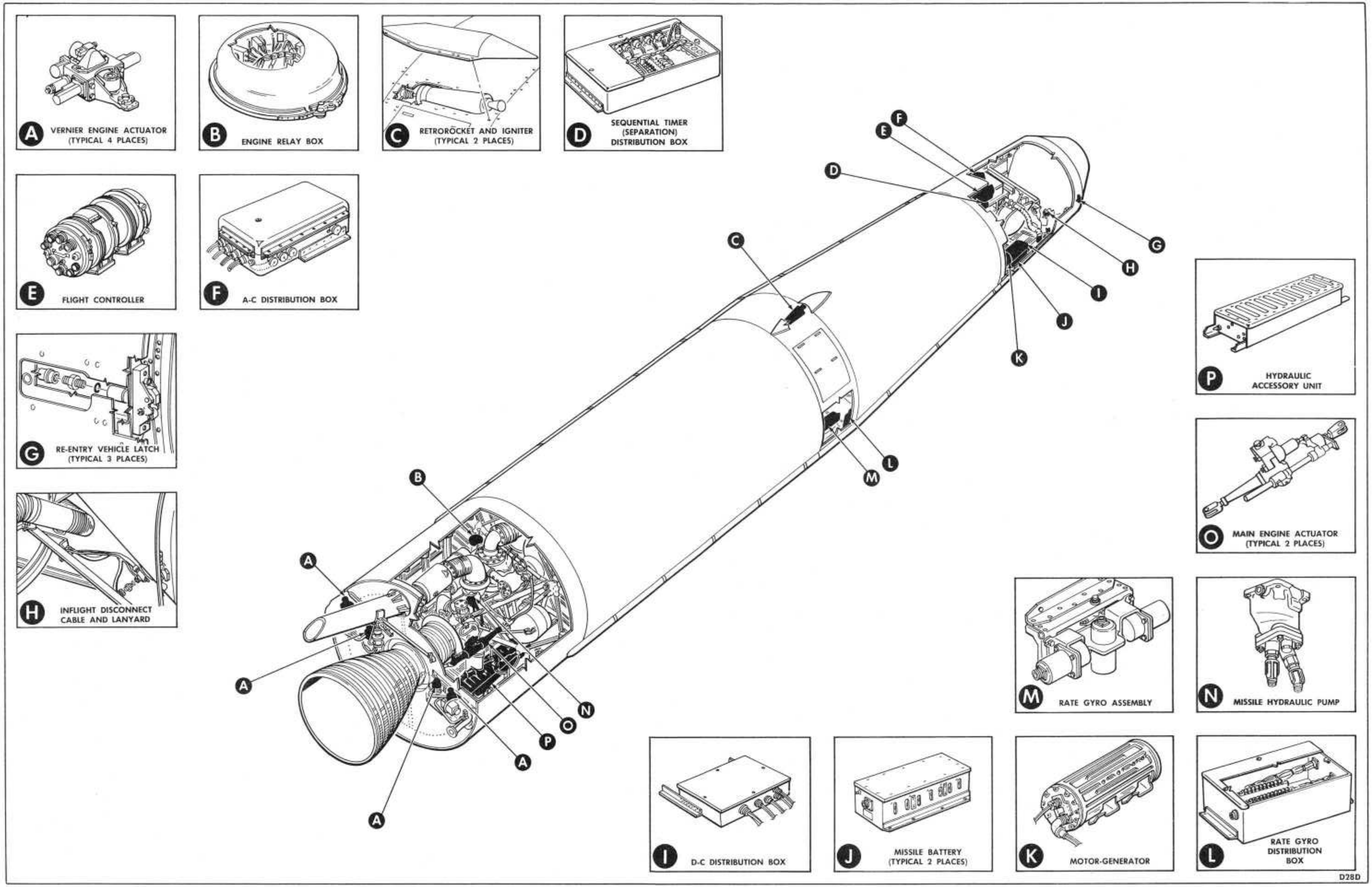


Figure 9-3. Flight Control System Airborne Components

Table 9-1. Flight Control System Airborne Components (Continued)

Equipment Name	*Figure Reference*	*Purpose*	*Characteristics*
In-flight disconnect cable and lanyard	H, 9-3	To disconnect re-entry vehicle umbilical cable at time of separation.	Small electrically ignited squib mounted in umbilical disconnect plug is detonated at time of separation to create pressure within disconnect plug release cylinder thus forcing plug to separate from re-entry vehicle. Lanyard mechanically disengages electrical plug at missile end of cable if re-entry vehicle disconnect plug fails to separate.
Retrorockets and igniters	C, 9-3	To give missile body reverse thrust at time of re-entry vehicle separation thus aiding separation.	Small electrically ignited, solid propellant rocket engines attached diametrically opposite each other on center body section.
Rate gyro assembly	M, 9-3	Measures rate of angular deviation of missile from its prescribed attitude and generates error correction signals.	Unit is a platform with a rate-of-motion sensitive gyro mounted in each of missile axes. Assembly is mounted in center body section.
Rate gyro distribution box	L, 9-3	Receives and distributes signals and voltages to and from rate gyros.	Small unsealed unit containing terminal panels. Unit is mounted near rate gyro assembly in center body section.
Engine relay box	B, 9-3	Receives and distributes engine control signals from flight controller and ground support equipment.	Hermetically sealed unit containing relays and terminal boards. Unit is mounted on rocket engine support frame.
Hydraulic accessory unit	P, 9-3	Provides valves and components which control hydraulic system ground and inflight pressurization. Accumulator within unit maintains system pressure for a short period after main engine shutoff to allow final vernier steering adjustments to be made.	Sealed unit containing following components: reservoir, accumulator, filters, relief valves, and check valves. Unit is mounted in lower portion of engine and accessory section. It is sealed to prevent hydraulic fluid leakage from reaching engine components.
Missile hydraulic pump	N, 9-3	Provides prime source of 3000 psi hydraulic pressure for flight control system during flight.	Constant displacement piston type. Capacity g gpm at rated rpm. Unit is mounted on engine turbopump accessory pad.
Main engine actuator	O, 9-3	Position the main rocket engine in yaw and pitch axes. This movement changes engines line of thrust in relation to missiles center line and causes missile to change its flight path.	Double acting hydraulic actuator installed in yaw and pitch axes of the main rocket engine. Movement of piston is controlled by a servo valve mounted on cylinder.

(Continued on Page 9-7)

Table 9-1. Flight Control System Airborne Components (Continued)

Equipment Name	Figure Reference	Purpose	Characteristics
Vernier engine actuators	A, 9-3	Position vernier engines in yaw and pitch and roll axes. This movement changes engines line of thrust in relation to missiles center line and causes missile movement about yaw, pitch, and roll axes.	Double acting hydraulic actuator installed in yaw and pitch axes of each of vernier engines. controlled by a servo valve mounted on cylinder. Yaw and pitch command signals from flight controller cause vernier engines to move in same direction, and roll command signals cause vernier engines to move in opposite directions in pitch axis, thereby producing movement about roll axis of the missile.

9-10. GROUND SUPPORT EQUIPMENT. (See figure 9-4 and 9-5.)

9-11. Ground support equipment is used for two specific purposes within the system. It is used for checking out the system functionally to assure the proper operation of all of the system components and also during actual launch. Table 9-2 describes flight control GSE.

Table 9-2. Flight Control System Ground Support Equipment

Equipment Name	Figure Reference	Purpose	Characteristics
Trailer-Mounted Ballistic Missile System Checkout Station TTU-92/M	9-4 9-5	Provides equipment to checkout missile flight control system. Functional checkouts are made of the following: System power checkout (phase, frequency, voltage, and reference), system power control (internal, external, manual, and automatic), control signal monitoring (gyro, servo valve, and buzz voltages), engine gimbal control (directional and slewing checkout), programmer checkout, and target selector checkout.	Launch emplacement or RIM building positioned unit that contains equipment used to check out various missile systems. Following panels in missile checkout station are used to check out flight control system: power checkout panel, power control panel, signal monitor panel, gimbal control panel and programmer panel. Panels consist of various switches, pushbuttons, control knobs, meters and control lights for a visual check of flight control system.

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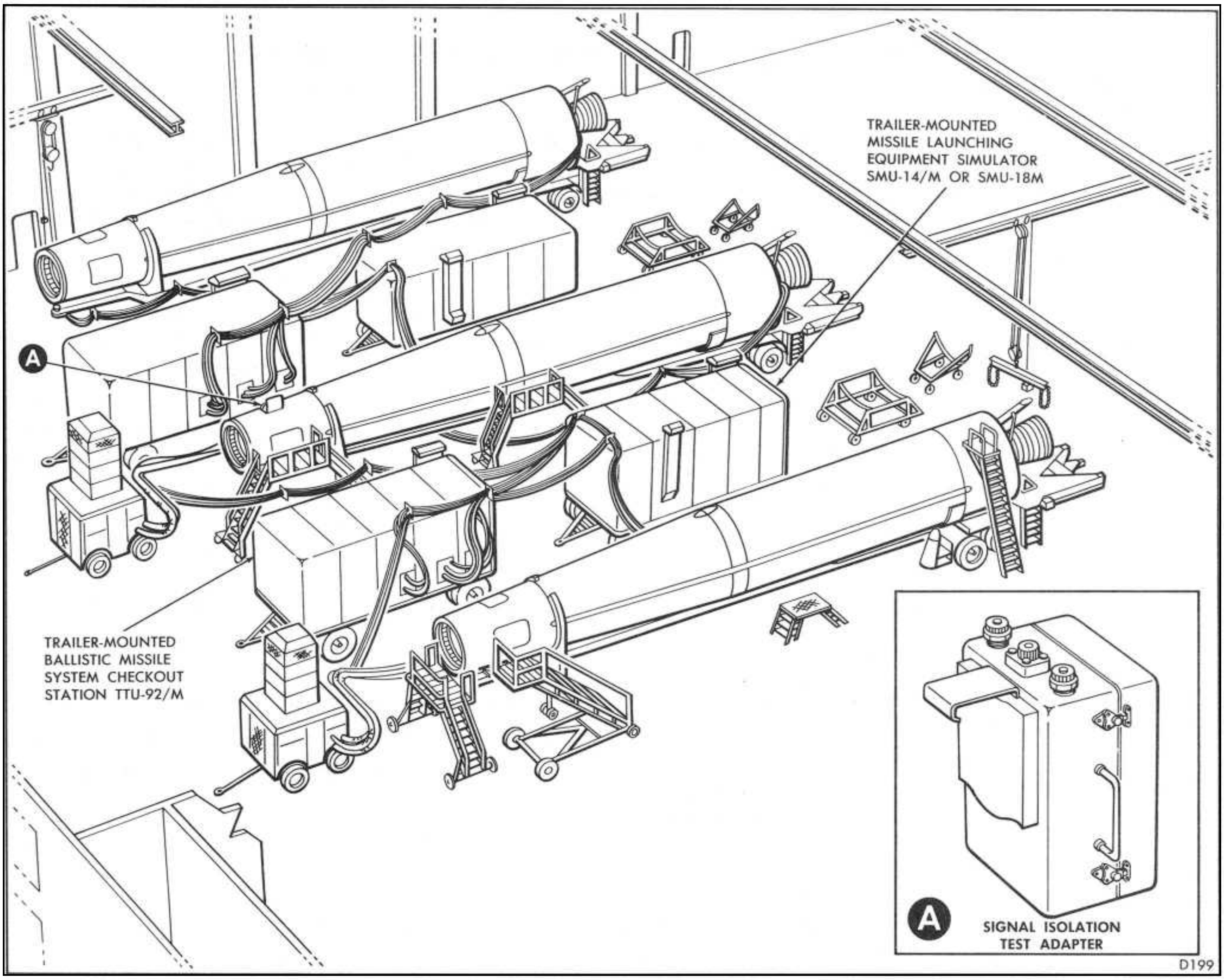


Figure 9-4. Flight Control System Ground Support Equipment — RIM Building

Table 9-2. Flight Control System Ground Support Equipment (Continued)

Equipment Name	*Figure Reference*	*Purpose*	*Characteristics*
Trailer-Mounted Missile Launching Countdown Group A/M24A-1	9-5	Provides equipment to furnish various power requirements for missile systems during checkout and countdowns. Contains equipment to monitor and sequence missile systems during an automatic countdown.	Launch emplacement positioned trailer that contains various power supplies, countdown sequencing, monitoring, and testing equipment. Furnishes following types of power: 28V d-c continuous, 28V d-c missile and GSE power, 28V d-c missile motor-generator power, 28V d-c guidance system power, and 115V a-c, 3-phase, 400-cycle missile and GSE power.

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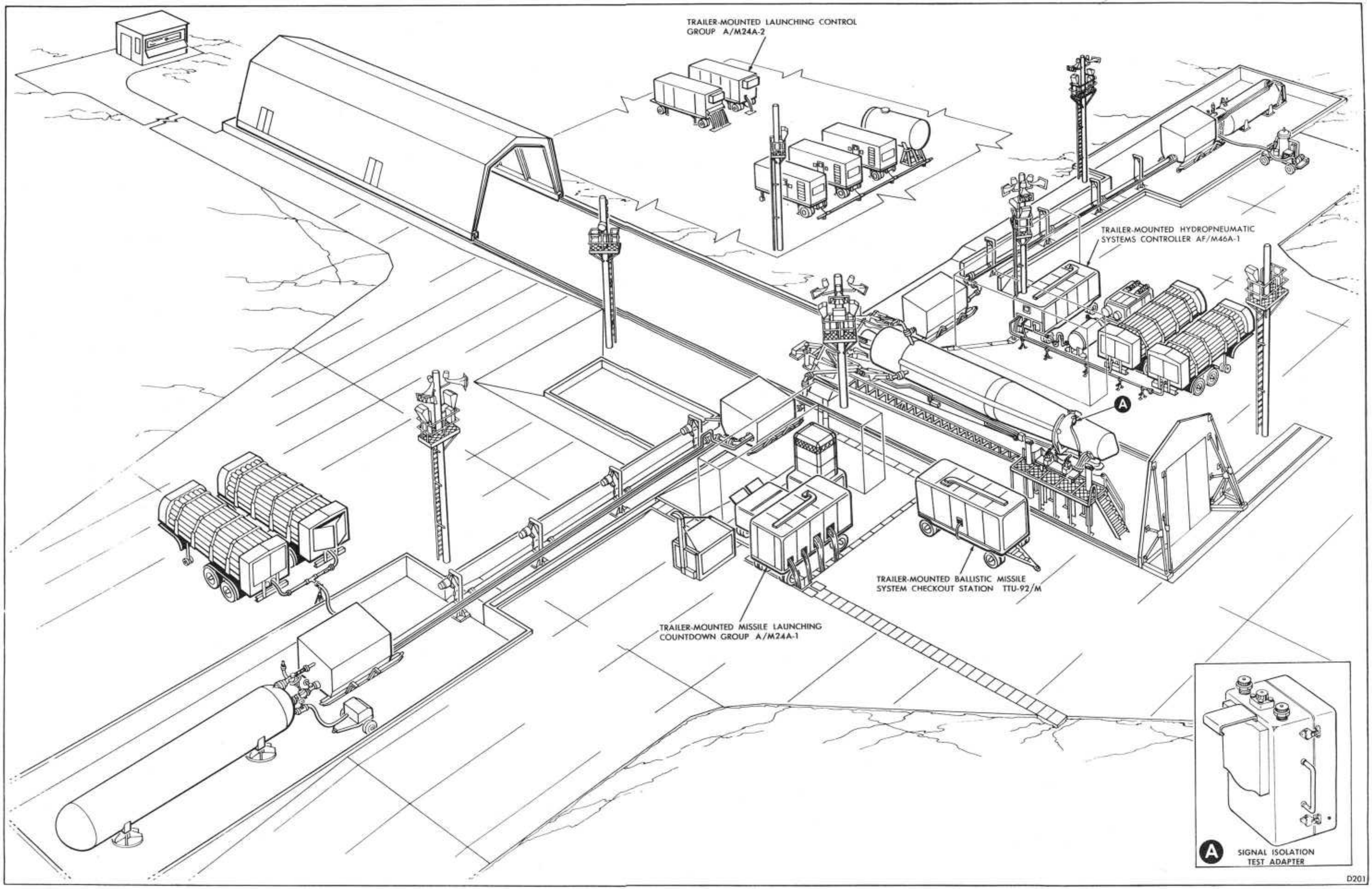


Figure 9-5. Flight Control System Ground Support Equipment — Launch Emplacement

Table 9-2. Flight Control System Ground Support Equipment (Continued)

Equipment Name	Figure Reference	Purpose	Characteristics
Trailer-Mounted Missile Launching Equipment Simulator SMU-14/M or SMU-18/M	9-4	Furnishes necessary electrical and hydraulic power requirements for missile systems checkout at RIM building.	RIM building positioned unit that simulates functions of hydropneumatic controller and launching countdown group. Contains equipment to furnish the following: 28V d-c continuous power, 28V d-c missile and GSE power, 28V d-c missile inverter power, 28V d-c, guidance system power, 115V a-c, 400-cycle, 3-phase power, and hydraulic pressure.
Trailer-Mounted Hydropneumatic Systems Controller AF/M46A-1	9-5	Furnishes hydraulic fluid pressure required to operate missile hydraulic system.	Launch emplacement positioned unit that supplies hydraulic and pneumatic power to various missile systems. Contains equipment to furnish hydraulic pressure and high-pressure pneumatic supply.
Trailer-Mounted Launching Control Group A/M24A-2	9-5	Controls status of three missiles at each of three launch emplacements. Places various missile systems in maintenance, checkout exercise, or ready status.	Launch control area positioned unit that contains equipment and personnel necessary to control launching of three missiles.
Signal isolation test adapter	9-4 9-5	Provides corrective circuitry in signal paths for accurate signal monitoring at missile checkout station.	Portable unit used at RIM building and launch emplacement. Unit is hung on edge of flight controller access door in guidance section of missile and permits connection of missile checkout station into system.

9-12. TEST EQUIPMENT.
(See figure 9-6.)

9-13. Special test equipment is used for functionally testing system components periodically as required after repair, and prior to initial installation in system. Table 9-3 describes this equipment.

Table 9-3. Flight Control System Component Test Equipment

Equipment Name	Figure Reference	Purpose	Characteristics
Ballistic Missile Flight Controller Test Stand TTU-37/E	9-6	To check out functionally operation of flight controller.	Consists of caster-mounted test stand and rate table with interconnecting cables. Flight controller is mounted in a gimbal fixture on rate table and rotated through yaw, pitch, and roll axes. Operating voltages are furnished by test stand, and functional capabilities of flight controller are monitored by four panels mounted on test stand.

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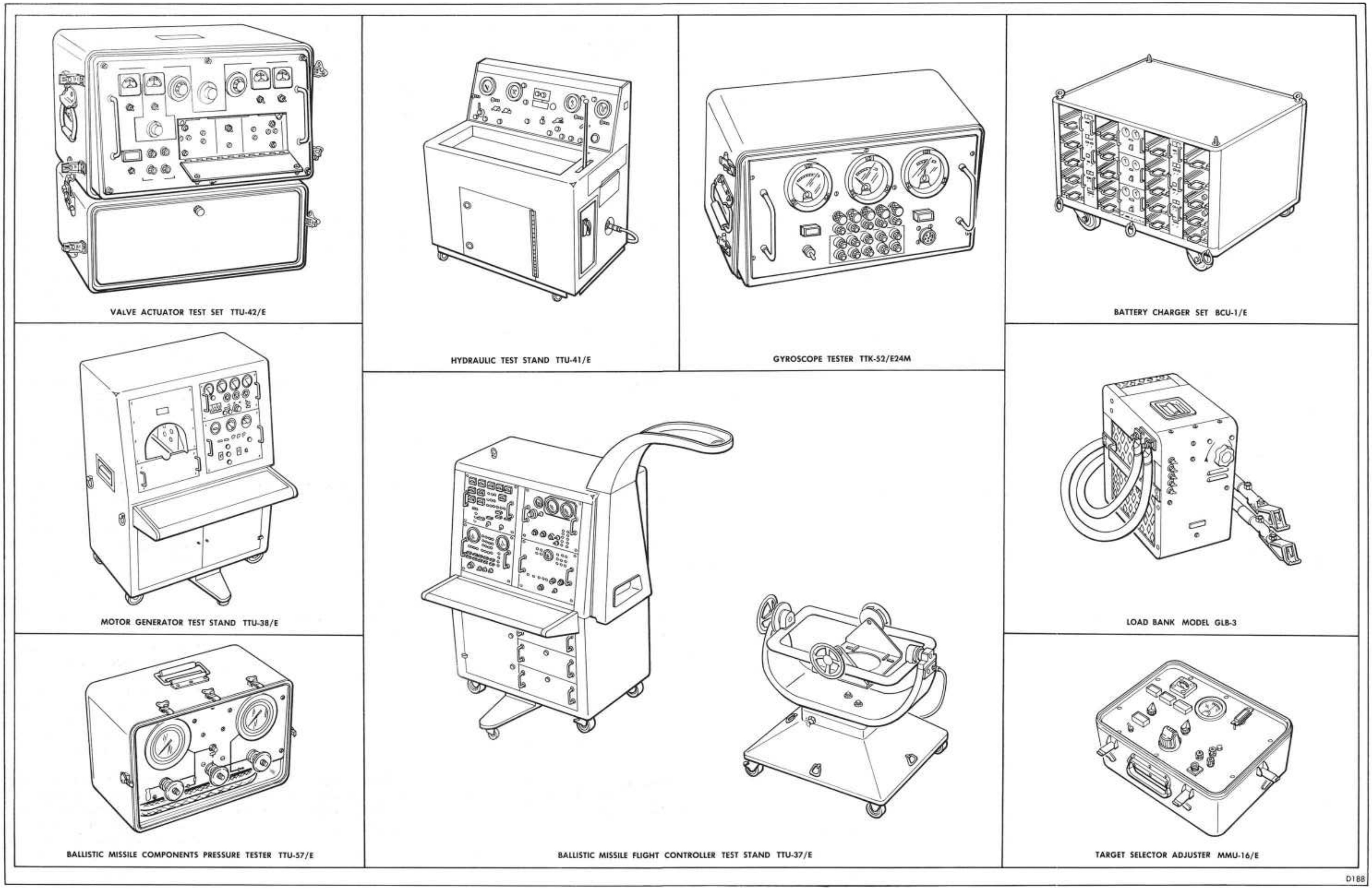


Figure 9-6. Flight Control System Components Test Equipment

Table 9-3. Flight Control System Component Test Equipment (Continued)

Equipment Name	*Figure Reference*	*Purpose*	*Characteristics*
Motor-Generator Test Stand TTU-38/E	9-6	To check out functionally operation of motor-generator prior to installation.	Caster-mounted stand with provisions for mounting motor-generator for testing. 28V d-c power is applied to motor-generator and 3-phase, 400-cycle output is monitored by two panels mounted on test stand.
Hydraulic Test Stand TTU-41/E	9-6	To perform tests on missile and GSE hydraulic components and lines.	Caster-mounted stand with provisions for connecting and regulating hydraulic pressure to hydraulic components. Hydraulic pressure is provided by either motor-driven hydraulic pump or a manually operated pump. Top of test stand contains a catch basin to prevent fluid spillage.
Battery Charger Test Set BCU-1/E	9-6	To charge missile batteries.	Caster-mounted stand with provisions for charging up to 20 batteries at a slow rate, or up to six batteries at a fast rate while simultaneously charging 14 batteries at a slow rate.
Gyroscope Tester TTK-52/E24M	9-6	To perform functional tests of rate gyros.	Portable unit with provisions for applying spin motor current and microsyn field current to a rate gyro under test. Operating capabilities are monitored by three meters and two indicating lights mounted on panel of tester.
Valve Actuator Test Set TTU-42/E	9-6	To perform functional tests on missile hydraulic actuators.	Portable test set with provisions for applying varying amounts of current to windings of servo valve while unit is pressurized. Amount and direction of actuator movement is monitored by meters mounted on panel of tester. Test set is used at RIM building and launch emplacement.
Ballistic Missile Components Pressure Tester TTU-57/E	9-6	To check out pressurization of flight controller and motor-generator to assure units are completely sealed.	Portable test set with provisions for applying regulated pneumatic pressure to flight controller and motor-generator cases. Amount of leakage is monitored by a pressure gage mounted on panel of tester.

(Continued on Page 9-13)

Table 9-3. Flight Control System Component Test Equipment (Continued)

Equipment Name	*Figure Reference*	*Purpose*	*Characteristics*
Load Bank Model GLB-3	9-6	To make cell voltage checks of missile batteries, and discharge from flight controller for pre-	Portable unit with provisions for absorbing battery current up to a rate of 100 amps at 33V dc. Load bank is used in conjunction with a d-c ammeter during checkout of battery discharge rate.
Target Selector Adjuster MMU-16/E	9-6	To adjust and test target selector. Target selector is removed from flight controller for preliminary setting.	Portable unit with provisions for setting two roll (azimuth) variable resistors in target selector. Variable resistors are set to specific values by means of a precision bridge circuit. Placement of the range and direction jumper wires monitored by indicator lights on panel of adjuster.

9-14. OPERATION.

9-15. DELIVERY TO LAUNCH.

9-16. From the time of receipt of the missile from the factory until it is placed in operational (ready) status, the flight control system, together with the other missile systems, is thoroughly checked and serviced. The sequence of operations includes a complete inspection, checkout, and servicing of the system at the RIM building. After the RIM building operations have been completed the missile is transported to the launch emplacement where the system is again checked.

9-17. RIM BUILDING CHECKOUT. The RIM building is equipped with specialized test equipment to perform final adjustments and servicing on the various system components. The components requiring servicing or adjustment are removed from the missile, adjusted, serviced, and reinstalled in the missile. Following the preliminary adjustment and servicing of system components the system as a unit is ready to be operationally checked out. The operational checkout is performed using three pieces of ground support equipment; the Trailer-Mounted Ballistic Missile Systems Checkout Station TTU-92/M, Trailer-Mounted Missile Launching Equipment Simulator SMU-14/M or SMU-18/M, and the signal isolation test adapter. These units contain power, control, and monitoring equipment which enable technical personnel to evaluate the system operational capability.

9-18. LAUNCH EMPLACEMENT CHECKOUT. Upon completion of the RIM building operations, the missile is transported to the launch emplacement. A series of checkouts is again performed to assure that the system has not been damaged during transport. Countdown exercises are then performed to prove that the launch emplacement equipment and all the missile systems are compatible. The major checks made to the flight control system during the countdown exercises are as follows: T-15, external power is applied to the missile from ground support equipment; T-14.5, hydraulic system is pressurized; T-10, first automatic engine deflection, (gimbal check, which checks system operation on external power and consists of uncaging individual HIG gyros, applying slewing currents which cause the engines to deflect, and recaging the gyros to return the engines to center position); T-2, second automatic engine deflection. (Checks system operation on missile internal power supplied by the missile batteries and the motor-generator). The same sequence of automatic engine deflections is used as on the external power check.

9-19. AIRBORNE.

9-20. HYDRAULIC AND ELECTRICAL POWER SYSTEMS. Electrical power for system operation during powered flight *(figure 9-7)* is supplied by two 28V d-c batteries connected in parallel. The batteries have a combined capacity of 40 ampere-hours of operation. A portion of the battery power is supplied to the missile motor-generator which in turn supplies 115V, 3-phase 400-cycle power to the flight controller. In the flight controller this power is converted into re-

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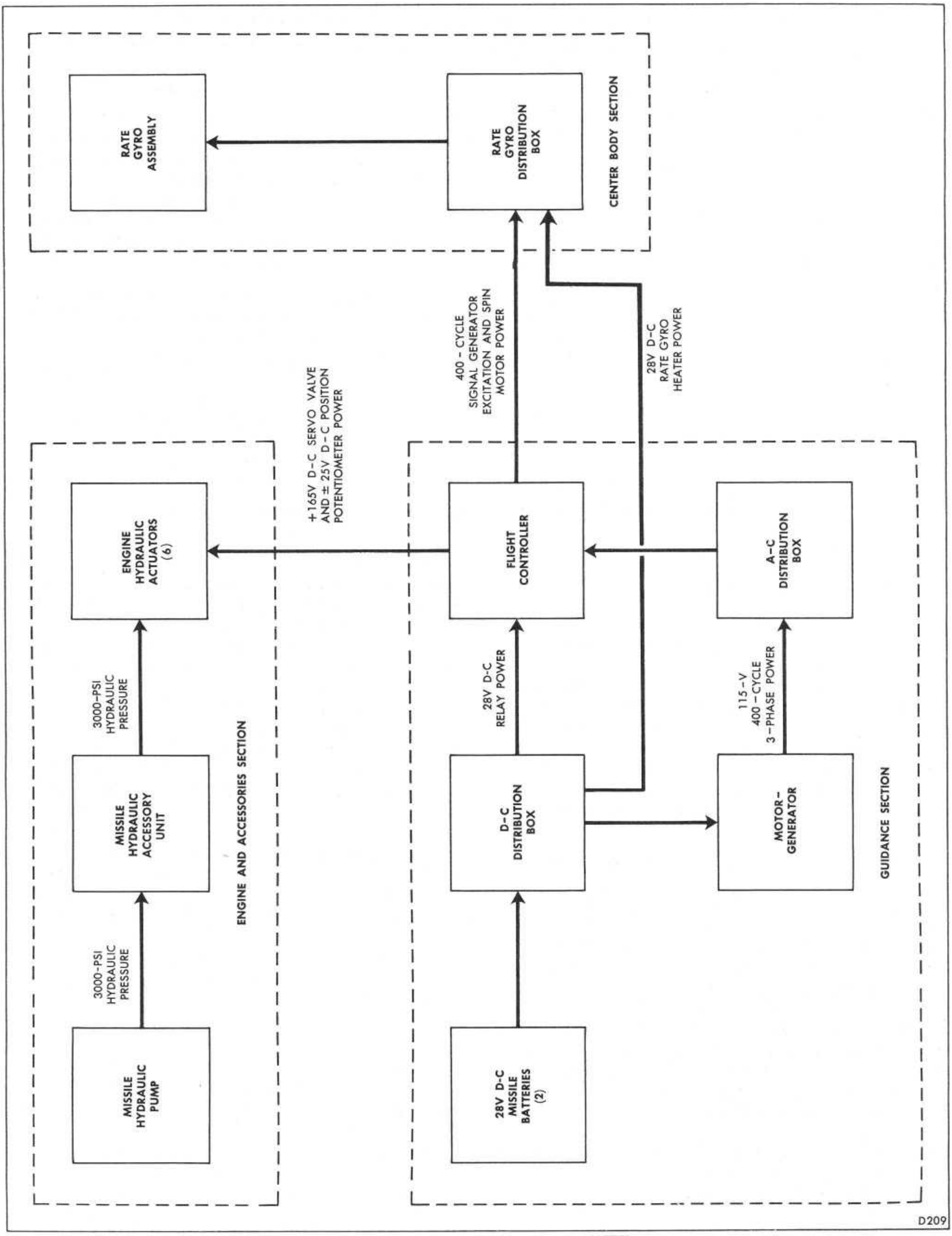


Figure 9-7. Flight Control System Electrical and Hydraulic Power — Data Flow Diagram

(Continued from Page 9-13)

quired a-c and d-c voltages for system operation. Missile electrical power also supplies the guidance system.

9-21. Hydraulic power for system operation is furnished during airborne flight by the missile hydraulic pump which is attached to the engine turbopump accessory pad. The pump delivers hydraulic fluid at a rate of 4 gallons per minute under 3000 psi to the hydraulic accessory unit which distributes it to the engine actuator servo valves. The hydraulic accessory unit contains a pneumatically pressurized hydraulic accumulator which is used to supply hydraulic pressure during system surge demands that exceed system capacity, also for vernier engine control during the short period of missile flight after the main engine has been cut off.

9-22. Because it is not feasible to operate the missile engines except at an actual missile launch, the hydraulic system power for checkout and countdown exercises is supplied from GSE hydraulic pumping units.

9-23. Ground support equipment power supplies are substituted for the missile batteries during checkout and countdown exercises except during the last 2 minutes (approximately) of the countdown. Then the system is switched to internal operation using the missile batteries. These batteries must be replaced immediately after the countdown.

SECTION X

GUIDANCE SYSTEM

10-1. PURPOSE.

10-2. The purpose of the airborne guidance system equipment (figure 10-1) is to provide the flight control system with information on pitch and yaw steering requirements, provide the flight control system with engine cutoff information, and provide the warhead with a prearm signal. The guidance system ground support equipment is used to align, check out, troubleshoot, and handle the airborne equipment.

10-3. DESCRIPTION.

10-4. The guidance system is described in the following five categories:

a. airborne guidance equipment

b. operational ground support equipment

c. test ground support equipment

d. optical alignment equipment

e. ground handling equipment

10-5. AIRBORNE EQUIPMENT.

10-6. The airborne guidance equipment is officially designated as the Missile Guidance Set AN/DJW-5 (figure 10-2). It is composed of the Gyro Stabilized Platform Group OA-2012/DJW-5, the Missile Guidance Control Group OA-1866/DJW-5, a cable which provides electrical connections between two airborne components, and a branched wiring harness.

10-7. PLATFORM GROUP. The platform group (figure 10-3) is composed of the stabilized platform and an upper and lower mount. Two mounts are equipped with rollers that slide on tracks in the guidance section of the missile.

10-8. The stabilized platform external parts are the left-hand and right-hand shrouds and the support gimbal. The right-hand shroud is a hemispherical-shaped metal cover with two windows and an outlet shroud valve. The left-hand shroud is the same shape and has an inlet shroud valve.

10-9. With the shrouds removed, the stabilized platform gimbals and inner assemblies are exposed (figure 10-4). A roll gimbal is pivoted on the support gimbal which is fixed to the frame of the missile. A yaw gimbal is pivoted on the roll gimbal. The inertial platform (pitch gimbal) is pivoted on the yaw gimbal. The gyro accelerometer assemblies and the stabilization gyro assemblies are mounted on the inertial platform. Three torque motors are provided to position the gimbals and inertial platform. The vertical sensing element is mounted on an extension of the inertial platform axis. The fixed and movable mirrors are also mounted on the stabilized platform.

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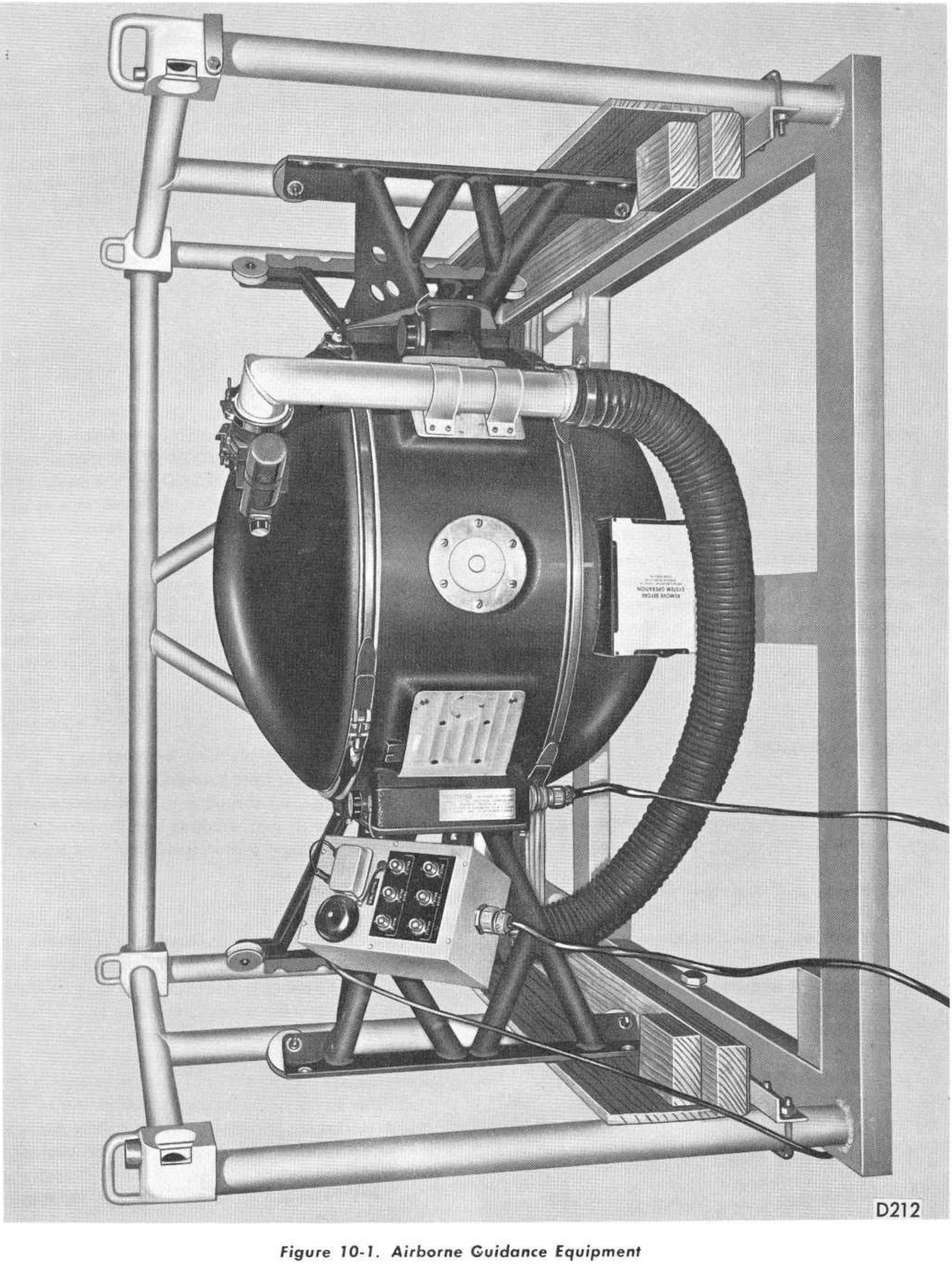


Figure 10-1. Airborne Guidance Equipment

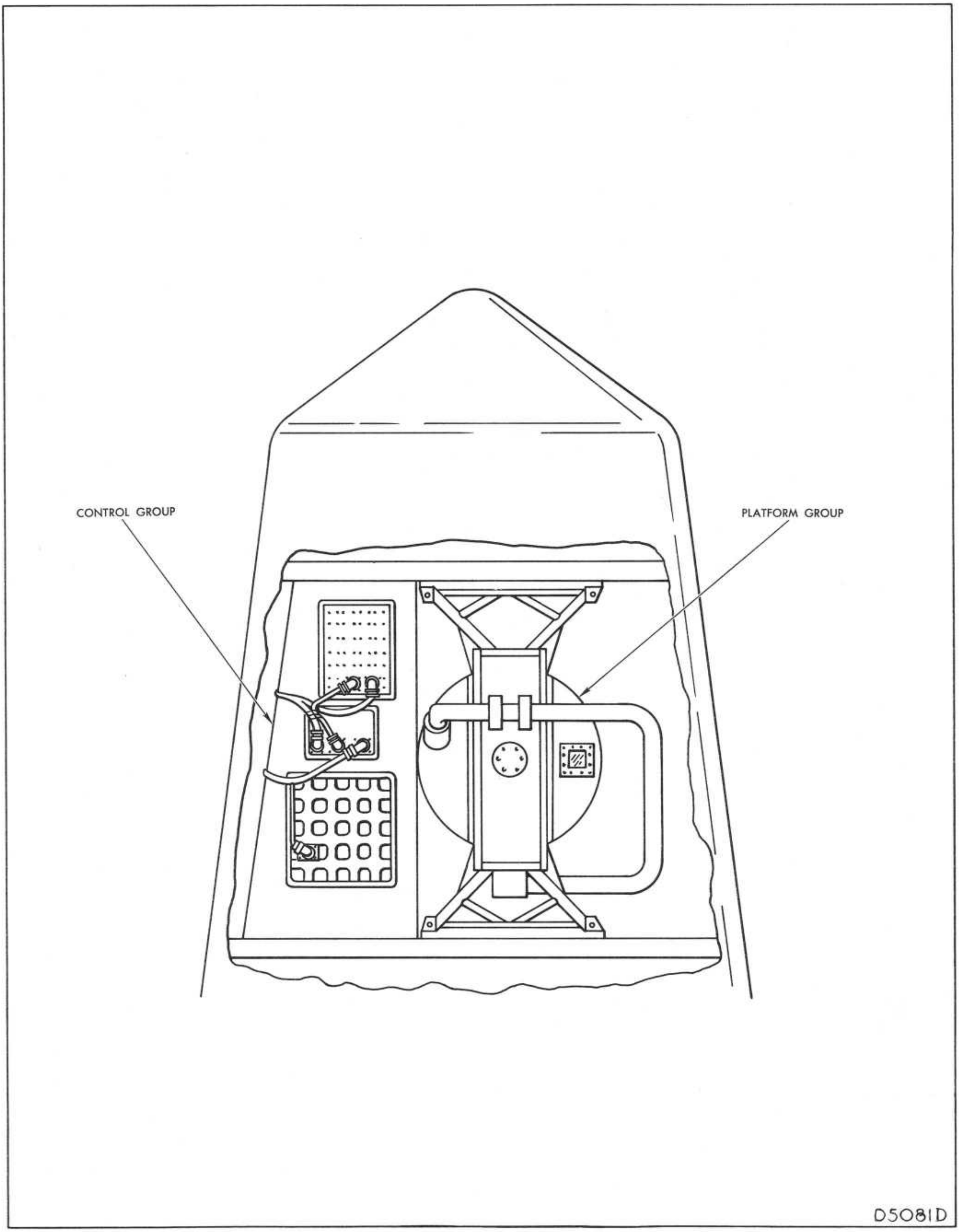


Figure 10-2. Missile Guidance Set AN/DJW-5

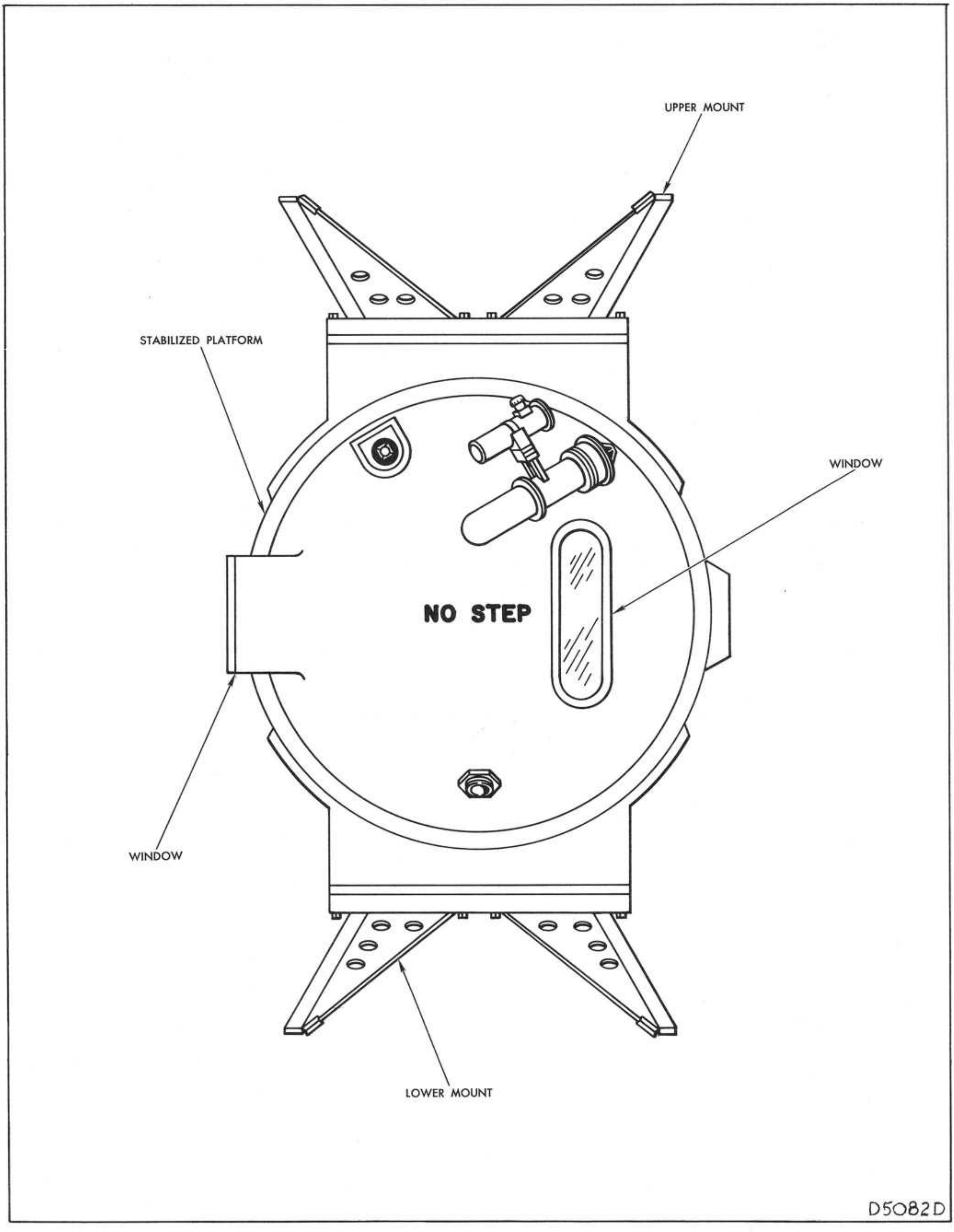


Figure 10-3. Platform Group

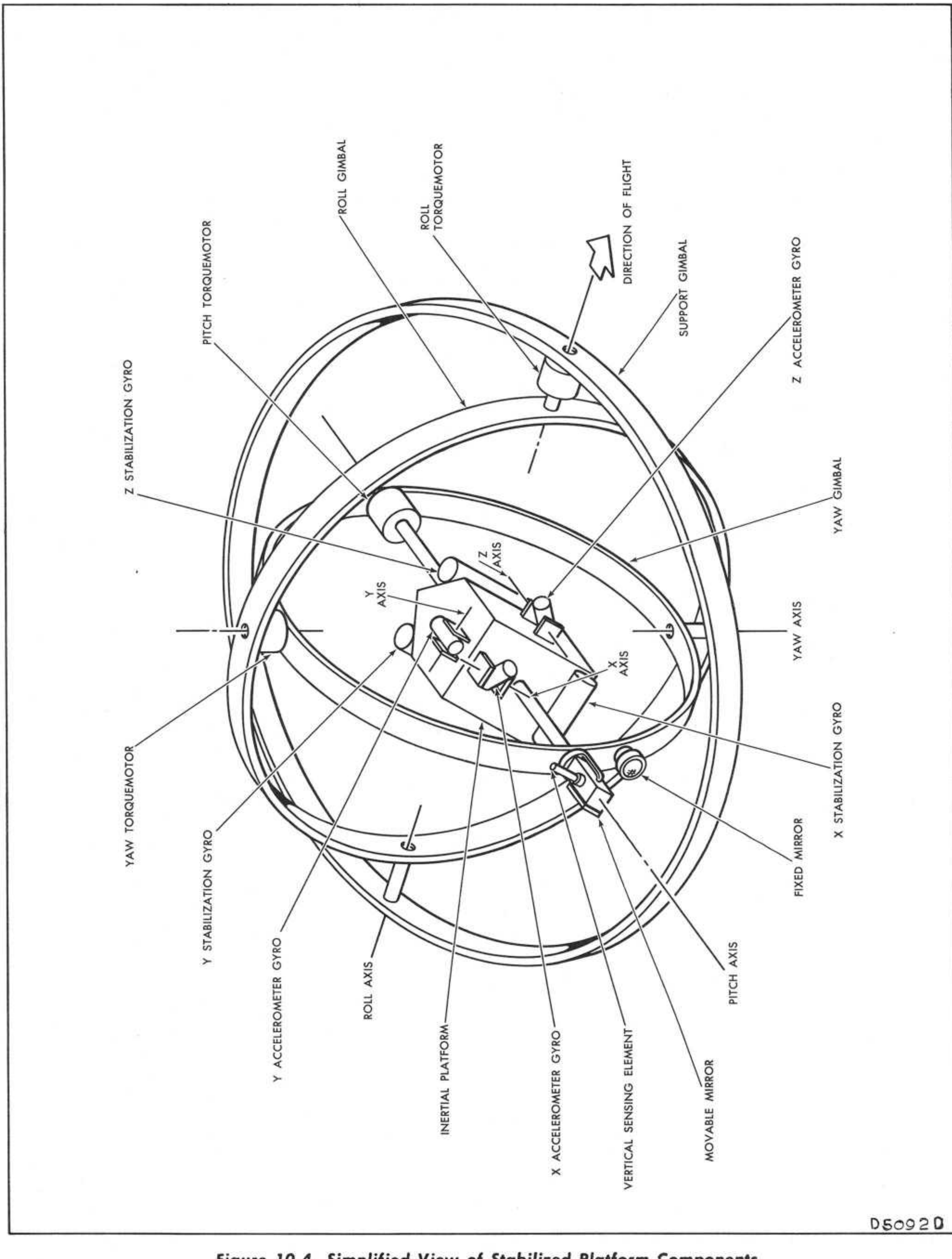


Figure 10-4. Simplified View of Stabilized Platform Components

(Continued from Page 10-1)

10-10. CONTROL GROUP. The control group (figure 10-5) is composed of a distribution box, PU-411 motor-generator, PU-424 motor-generator; AM-1743, AM-1744, and AM-1745 amplifiers, CP-372 computer, arming control, PP-1811 power supply, and a CN-448 regulator. These components are mounted on a rack equipped with rollers so that it can be installed on tracks in the guidance section of the missile. Refer to table 10-1 for the purposes and characteristics of the control group components.

Table 10-1. Control Group Components

Equipment Name	*Figure No.*	*Purpose*	*Characteristics*
Amplifier AM-1743	10-5	Receives and amplifies positional error signals from stabilized platform and provides field excitation for three generators of PU-424 motor-generator.	Pressurized component containing three electronic amplifier channels which receive and amplify stabilization error signals.
Motor-generator PU-424	10-5	Provides current to proper gimbal torque motor on stabilized platform when stabilization error signal is received.	An unpressurized component containing motor and three generators on a common shaft.
Amplifier AM-1744	10-5	Isolates CP-372 computer electronic circuits from other circuits in system, and amplifiers receiver synchro error signals sufficiently to drive velocity-to-be gained potentiometer motors in CP-372 computer.	Pressurized component containing computer repeater and computer isolation amplifiers.
Computer CP-372	10-5	Provides velocity-to-be gained, engine cutoff, steering, and prearm signals.	Unpressurized component containing velocity-to-be gained potentiometers, switches and circuitry necessary to compute velocity-to-be gained, steering, engine cutoff, and prearm signals.
Amplifier AM-1745	10-5	Provides drive signal to a motor tachometer to rotate accelerometers, and provides control current for each accelerometer torque microsyn.	Pressurized component containing six electronic amplifier channels, Q potentiometers, and accelerometer compensation potentiometers.
Motor Generator PU-411	10-5	Provides 115V a-c, 400-cycle power to airborne components.	Unpressurized Component containing a d-c motor and an a-c generator.
Regulator CN-448	10-5	Provides regulation of frequency and voltage outputs of PU-411.	Pressurized component containing a frequency standard assembly, frequency controller assembly, and a voltage control assembly.
Power Supply PP-1811	10-5	Provides 270V B+, gyro torque microsyn reference current, and precision power for guidance set.	Pressurized component containing 270V B+ power supply, precision amplitude supply, precision amplitude supply, and gyro torque microsyn reference excitation amplifier.

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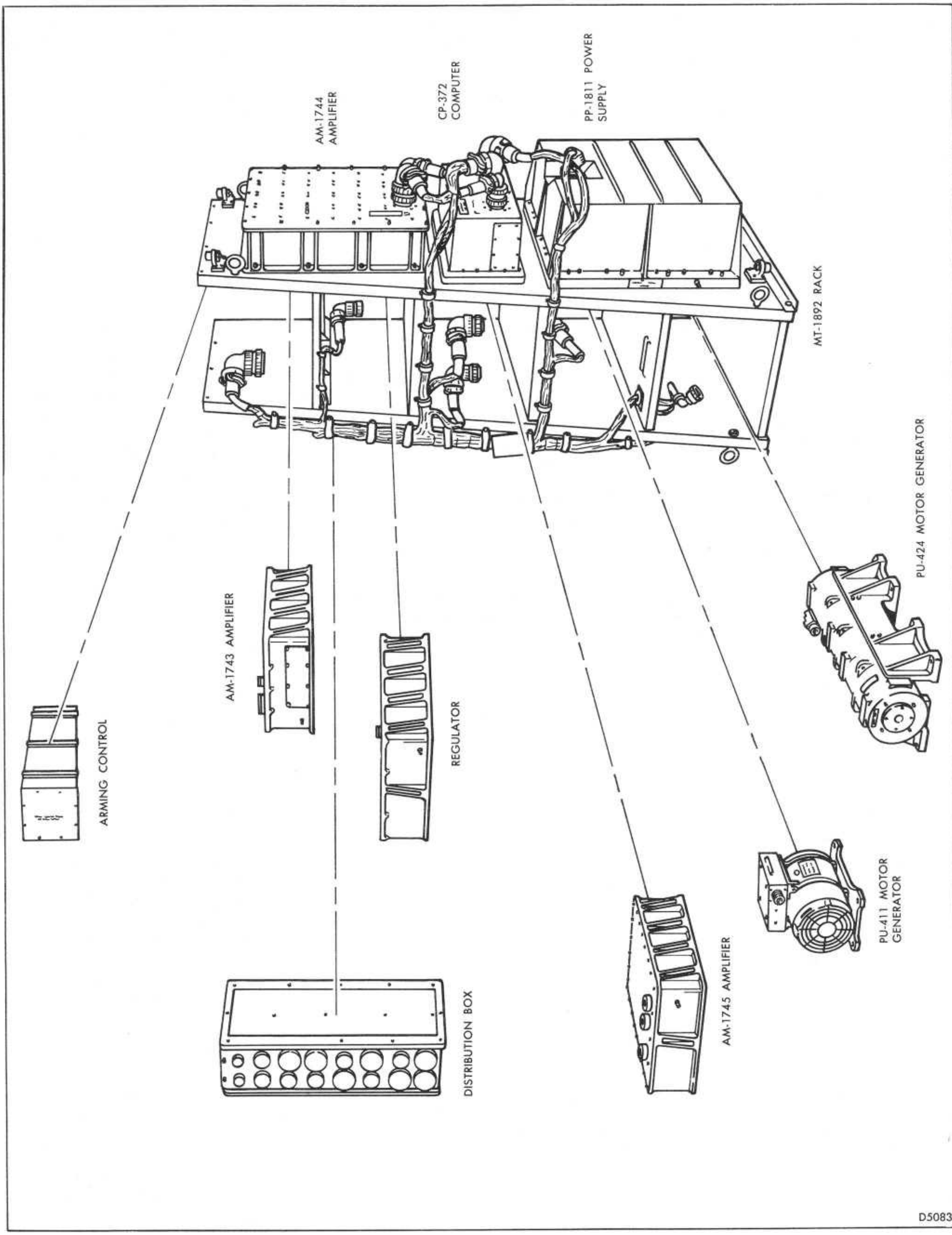


Figure 10-5. Control Group Components

Table 10-1. Control Group Components (Continued)

Equipment Name	*Figure No.*	*Purpose*	*Characteristics*
Distribution box J-868	10-5	Provides junction points for guidance set signals.	Pressurized component containing relays and circuitry for providing distribution of guidance set signals.

10-11. OPERATIONAL GROUND SUPPORT EQUIPMENT.

10-12. Operational ground support equipment (figure 10-6) is used to align the airborne guidance set to a particular target and to monitor guidance set operation. This equipment is located at the launch emplacement in the launching countdown group and the launching control group. The following paragraphs and table 10-2 describe this equipment.

10-13. MISSILE GUIDANCE ALIGNMENT SET AN/GJQ-5. This equipment is installed in the launching countdown group. There are 14 sliding drawer components plus interconnection cabling that make up the alignment set. At the launch emplacement, this equipment is connected to the airborne guidance set through the umbilical cables. Table 10-2 lists the purposes and characteristics of the alignment set component drawers.

Table 10-2. Alignment Set Components

Component	*Figure No.*	*Purpose*	*Characteristics*
Indicator control	10-6	Provides digital voltmeter readout of guidance system voltages, a meter to monitor stabilization gyro performance and a selector for monitoring digital voltmeter and MX-2370 counter functions.	Trailer-mounted component, containing a readout indicator for various guidance system voltages, a stabilization gyro output meter for indicating gyro performance, a gyro stabilization output selector for providing desired channel, a voltmeter selector to select desired voltage to be indicated on readout indicator, an EPUT selector to select desired circuit condition, and an external voltage jack for an external source of a-c or d-c voltage. Predetermined counter which furnishes start and stop pulses for EPUT meter is located behind panel face.
Accelerometer control	10-6	Monitoring accelerometer performance.	Trailer-mounted component, containing meters which monitor accelerometer performance, controls which effect accelerometer performance, and a series of indicator lights which show which guidance system power circuits are operative.

(Continued on Page 10-10)

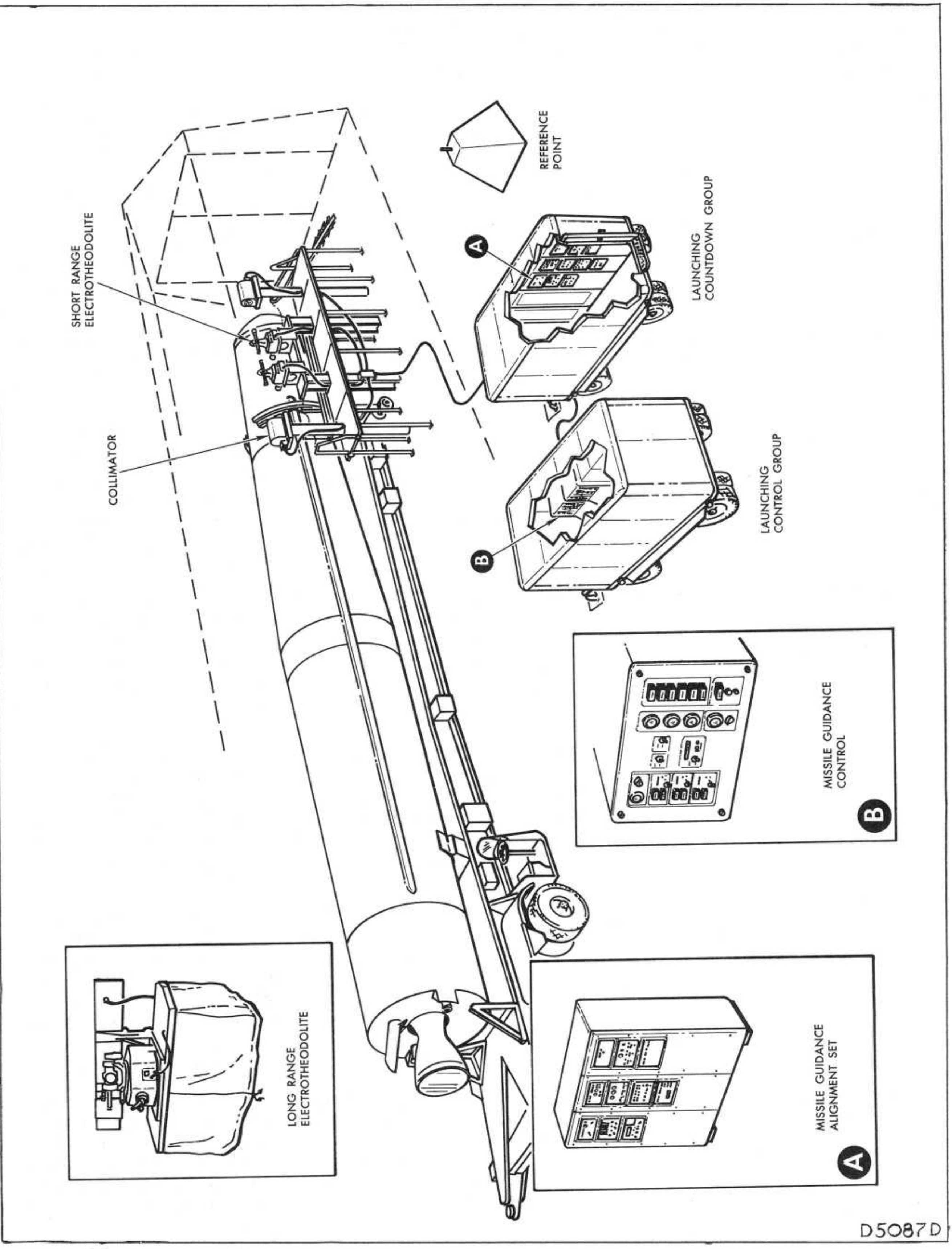


Figure 10-6. Launch Emplacement Installation of Ground Support Equipment

Table 10-2. Alignment Set Components (Continued)

Component	*Figure No.*	*Purpose*	*Characteristics*
Gimbal control	10-6	Setting and monitoring gimbal attitude.	Trailer-mounted component that contains controls, meters, and indicators associated with setting and monitoring of stabilized platform gimbal attitude.
Azimuth control	10-6	Controlling the position of the movable azimuth mirror mounted on stabilized platform.	Trailer-mounted component that contains an indicator and controls for setting movable azimuth mirror.
Velocity control	10-6	Setting the values of velocity-to-be gained into the Vg potentiometers in guidance set and to control computer problem check test.	Trailer-mounted component that contains a meter, controls, and indicators for setting values of velocity-to-be-gained into Vg potentiometers.
Erection control	10-6	Monitoring the values of compensation for earth-rate torque being supplied to stabilization gyros in guidance set.	Trailer-mounted component, containing three indicators which display values of compensation of earth-rate torque being supplied to stabilization gyros.
Alignment control	10-6	Selecting guidance set operational conditions and advancing guidance set through successive modes of operation to desired alignment.	Trailer-mounted component, containing switches and circuitry which are used to progress guidance set through various modes of operation until inertial platform is erected to desired alignment.
Electrotheodolite amplifier	10-6	Provides amplification for short range electrotheodolite error signals and means of monitoring gyro heater circuits, guidance system power circuits, and guidance alignment running time.	Trailer - mounted component, containing electronic circuits associated with short range electrotheodolite error signals. Panel also contains gyro heater cycling lights and guidance system fuses.
Recorder RD-184	10-6	Provides visual recording of stabilization and accelerometer loop performance.	Trailer - mounted component, containing instruments that provide a visual record of stabilization and accelerometer loop performance. Record is in form of a recorder tape graph. Instrument is used to record response to error signals.
Counter MX-2370	10-6	Measuring inverter frequency, accelerometer rate, and computer problem time. The MX-2370 counter provides decimal counting units to indicate elapsed time.	Trailer - mounted component, containing a digital counter which can be set to monitor several guidance system functions. Elapsed time indications are read out on indicator on panel face.

(Continued on Page 10-11)

Table 10-2. Alignment Set Components (Continued)

Component	*Figure No.*	*Purpose*	*Characteristics*
Digital voltmeter	10-6	Provides electronic circuitry for measuring voltages.	Trailer-mounted component which has no controls or indicators on its panel face. The digital voltmeter component drawer contains the electric circuits associated with voltage readout on indicator control panel.
Voltage regulator	10-6	Provides voltage regulation for the 115V, 60-cycle ground power supplied to the alignment set.	Trailer-mounted component which has no controls or indicators on its panel face. Voltage regulator component drawer contains electronic circuits associated with voltage regulation.
Power supply PP-1917	10-6	Provides ground power for alignment set.	Trailer-mounted component which has no controls or indicators on its panel face. Power supply component drawer contains electronic circuits associated with developing ground power for alignment set.
Electrotheodolite adapter power assembly	10-6	Provides filament power and interconnection circuits to short range electro-theodolite.	Trailer-mounted component which has no controls or indicators on its panel face. Electrotheodolite adapter power assembly drawer contains electronic circuits associated with development of filament power and interconnections to short range electrotheodolite.

10-14. MISSILE GUIDANCE CONTROL C-399/GJQ. The guidance control is located in the launching control group at the launch position for remote operation and monitoring of the guidance system during countdown operation. A console-mounted guidance control is also used in the RIM building.

10-15. OPTICAL ALIGNMENT EQUIPMENT.

10-16. Table 10-3 lists the purposes of the optical alignment equipment located at the launch emplacement. (Refer to figure 10-6.)

Table 10-3. Optical Alignment Equipment

Component	*Figure No.*	*Purpose*
Short Range azimuth alignment electrotheodolite MX-2376-DJM	10-6	Provides azimuth reference for stabilized platform when missile is in horizontal position.

(Continued on Page 10-12)

Table 10-3. Optical Alignment Equipment (Continued)

Component	*Figure No.*	*Purpose*
Target collimator	10-6	Provides an all weather reference point for aligning short range electrotheodolites.
Reference target	10-6	Provides an aiming point, when establishing angular position of collimators and short and long range electrotheodolites.
Long Range azimuth Alignment Electrotheodolite MX-2377-DJM	10-6	Provides azimuth reference for stabilized platform when missile is in a vertical position.

10-17. TEST GROUND SUPPORT EQUIPMENT.

10-18. Test ground support equipment is used in maintenance and checkout operations. Table 10-4 lists the purposes and characteristics of the individual items. Figure 10-7 illustrates these items as they are arranged in the guidance system bench repair shop area of the RIM building. Some of these items are also used in the missile maintenance area of the RIM building during checkout procedures which are accomplished with the guidance set installed in the missile.

Table 10-4. Test Ground Support Equipment

Component	*Figure Reference*	*Purpose*	*Characteristics*
Missile Guidance Alignment Console AN/GJQ-7	P, 10-7 10-9	Calibrating, checking, and troubleshooting guidance system in guidance system bench repair area of RIM building. Accomplishes same functions in missile maintenance area when mounted in missile launching equipment simulator.	Characteristics of the 14 drawer-mounted components are identical to components of alignment set as described in table 10-2. Drawer components are mounted in a three-bay console in guidance system bench repair area. (figure 10-7.) Drawer components are also mounted in missile launching equipment simulator for use in missile maintenance area (figure 10-9).

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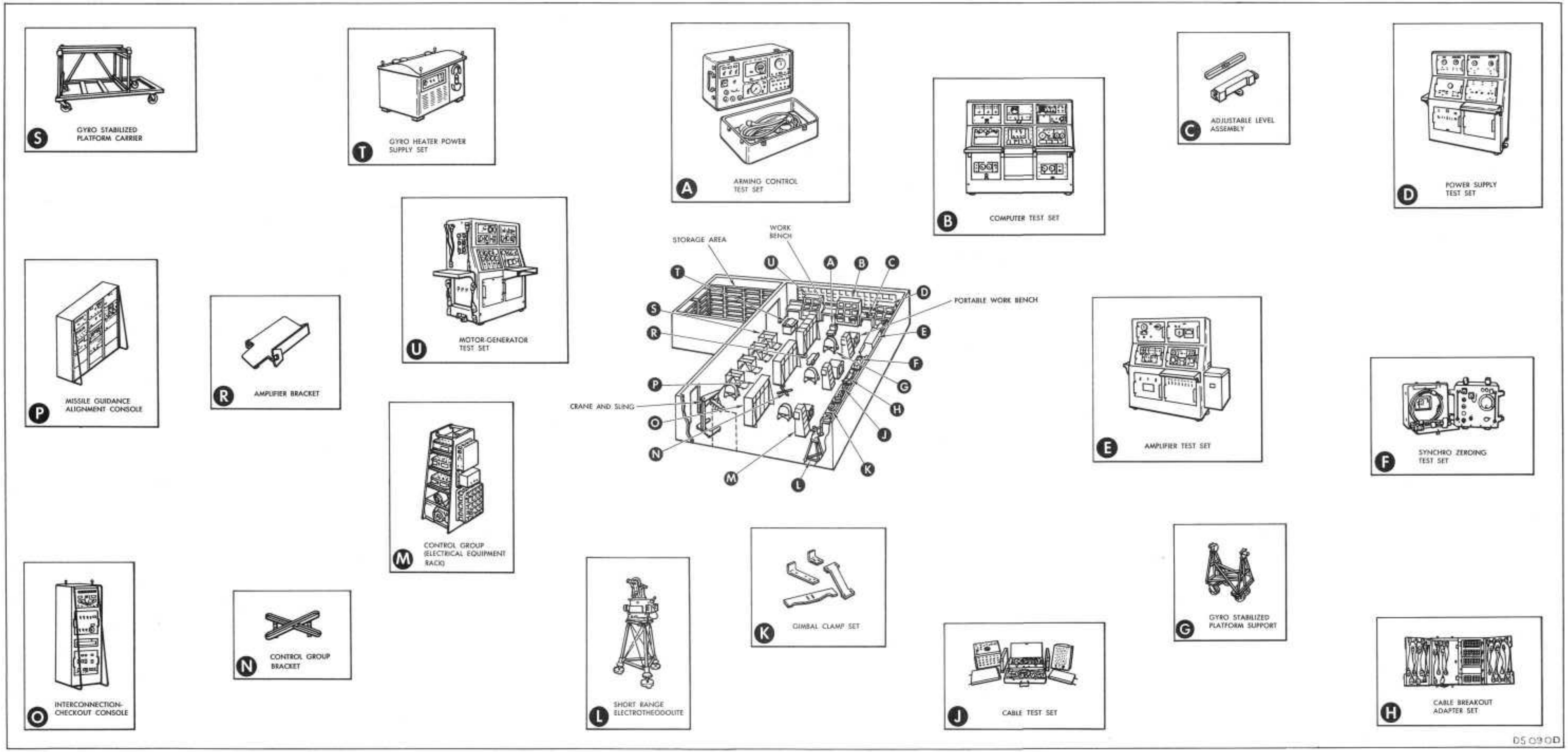


Figure 10-7. Guidance System Bench Repair Shop Area, Equipped

Table 10-4. Test Ground Support Equipment (Continued)

Component	*Figure Reference*	*Purpose*	*Characteristics*
Interconnection Checkout Console AN/DJM.	O, 10-7	Simulating signals normally received from airborne guidance set for checking out alignment console. Generates X-3 and first motion signals and provides power protection for checkout operations.	Interconnection-checkout console is composed of a checkout indicator, a power panel, and a protection panel, mounted in a one-bay console. Located in guidance system bench repair area of the RIM building and electrically connected to alignment console (figure 10-7).
Missile Guidance Test Set AN/DJM-2	10-7 10-9	Simulating signals normally received from airborne guidance set for checking out alignment set.	Guidance test set is identical to checkout indicator component of interconnection-checkout console referred to in description of interconnection-checkout console. Referred to as guidance test set when installed in ballistic missile system checkout station. (figure 10-9.)
Synchro Zeroing Test Set AN/DJM-5	F, 10-7	Monitoring electrical zero positions of guidance system synchros during synchro alignment procedures.	Synchro zeroing set is a portable electronic device used for checking electrical zero position of guidance system synchros.
Cable Breakout Adapter Set AN/DJM-6	H, 10-7	Provides access to cable wires for connection of test equipment during troubleshooting or alignment procedure.	Cable breakout adapter set consists of a series of breakout boxes, cables and connectors. May be connected between components and cables, to provide access to cable wires for connection of test equipment during troubleshooting or alignment procedures.
Electrical Cable Test Set AN/DJM-4	J, 10-7	Checking continuity and insulation of cable wire.	Cable test set consists of a transmitter assembly, a receiver assembly, and a series of cable adapters.
Power Supply Test Set AN/DJM-11	D, 10-7	Checking the operation of airborne and ground support equipment, power supplies, and regulators.	Power supply test set is composed of a C-2543 control indicator, a C-2544 control-selector, a SB-923 protection panel, an ID-706 indicator, a C-2545 control-indicator, a dummy load, motor-generator, and associated cabling. These components are housed in a two-bay cabinet located in the guidance system bench repair shop area of RIM building.

(Continued on Page 10-15)

Table 10-4. Test Ground Support Equipment (Continued)

Component	*Figure Reference*	*Purpose*	*Characteristics*
Amplifier Test Set AN/DJM-9	E, 10-7	Checking operational characteristics of guidance system and ground support equipment amplifiers.	Amplifier test set is composed of a differential voltmeter, a monitor-indicator, a selector control, a voltmeter, an amplifier monitor, a PP-2055 power supply, and a CX-4472 harness. Components are housed in a two-bay cabinet in guidance system bench repair area of RIM building.
Motor-Generator Test Set AN/DJM-10	U, 10-7	Testing PU-411 and PU-424 motor generators.	Motor-generator test set is composed of a ZM-33 resistance bridge, a PP-2056 power supply, a protection monitor, an AC generator monitor, and a CX-4473 harness. Components are housed in the guidance system bench repair shop area of the RIM building.
Computer Test Set AN/DJM-7	B, 10-7	Testing CP-372 computer.	Computer test set is composed of a C-2512 control selector, an MX-2494 adapter, an SB-920 protection panel, an ME-148 voltmeter, an AM-1947 amplifier control, an RD-211 recorder, an OS-89 oscilloscope, a TS-1184 resistance bridge, an SG-303 signal generator, a PP-2045 power supply, and CX-4423 and CX-4424 harnesses. Components are mounted in a three-bay cabinet located in guidance system bench repair area RIM building.
Arming Control Test Set AN/DJM-6	A, 10-7	Checking type B arming control.	Arming control test set is composed of a cover assembly, a leveling fixture, a leveling indicator, a pressure valve, a lead assembly, and five cable assemblies to provide the type B arming control checks. Arming control test set is located in guidance system bench repair shop of RIM building.
Short Range Electrotheodolite tripod	L, 10-7	Support for short range electrotheodolite in guidance system bench repair area of RIM building.	Electrotheodolite tripod is used in conjunction with short range electrotheodolite in RIM building for all guidance set operations which require a short range electrotheodolite.

(Continued on Page 10-16)

Table 10-4. Test Ground Support Equipment (Continued)

Component	*Figure Reference*	*Purpose*	*Characteristics*
Adjustable level assembly	C, 10-7	Leveling inertial platform of stabilized platform.	Level assembly is used in RIM building to level inertial platform of stabilized platform when gyros are replaced.
Amplifier bracket set	R, 10-7	Provides a shelf for AM-1745 amplifier so adjustments to compensation and Q potentiometers can be made while amplifier is removed from, but electrically connected to, electrical equipment rack.	Amplifier bracket set consists of a removable shelf attached directly to rack to support AM-1745 amplifier.

10-19. GROUND HANDLING EQUIPMENT.

10-20. Ground handling equipment is used to physically maneuver guidance system components. When components are removed from or installed in the missile, moved about in maintenance areas, or positioned for adjustments, means of handling, transport, and gyro heat control must be provided. Table 10-5 describes each item of ground handling equipment. Figure 10-7 illustrates the nature of this equipment as it is used in the guidance system bench repair shop area of the RIM building.

Table 10-5. Ground Handling Equipment

Component	*Figure Reference*	*Purpose*	*Characteristics*
Gyro Heater Power Supply Set AN/GJQ-6	T, 10-7	Provides gyro heat whenever stabilized platform is not being supplied with gyro heater power from some other source. Provides conditioned air to guidance set during periods of hot or cold ambient temperatures.	Gyro heater power supply consists of a HD-319 blower, a C-2396 control, a generator set, a monitor panel, two 6V batteries, two 24V batteries, two inverters, and associated cabling. The components are mounted in the MT-1977 rack.
Gyro Stabilized Platform Support MT-1976/GJQ	G, 10-7	Moving and positioning the stabilized platform during maintenance operation.	Gyro stabilized platform support consists of a tubular frame structure mounted on casters with retractable jacks. It is supplied with two pivots with which to pivot stabilized platform for maintenance and inspection purposes.
Gyro Stabilized Platform Carrier V-147/GJQ	S, 10-7	Transporting stabilized platform.	Gyro stabilized platform carrier is a framework which is used in transporting gyro stabilized platform with its upper and lower mountings attached. Carrier provides space for mounting a gyro heater power pack adjacent to stabilized platform, while moving stabilized platform.

(Continued on Page 10-17)

Table 10-5. Ground Handling Equipment (Continued)

Component	Figure Reference	Purpose	Characteristics
Multiple Leg Sling ST-137/G	10-7	Provide s a mechanical coupling between a hoist and components of guidance set. Used in removing or replacing guidance set components from missile and in other handling operations.	Multiple leg sling is constructed of 2½-inch diameter steel tubing, ¼-inch cable, lifting lugs, connecting lugs, and hooks capable of supporting 1 ton.
Portable hydraulic crane	10-7	Handling guidance system components.	Portable hydraulic crane is used in conjunction with ST-137 sling.
Gimbal locking brackets and plate	K, 10-7	Locking gimbals in a specific position for prolonged storage.	Consists of four bracket assemblies which can be attached to gimbals of stabilized platform to maintain their position during prolonged storage.
Missile guidance control group support	10-7	Facilitates handling and positioning control group during maintenance procedures.	Missile guidance control group supports consist of two channel iron structures in an "X" configuration which may be attached to each end of missile guidance control group.

10-21. OPERATION.

10-22. From the time that a missile is received at the operational base until it is launched, the guidance system goes through a series of checks and calibrations designed to bring it to a countdown readiness condition and insure that it remains in this condition. The following paragraphs discuss these operations and the functions of the guidance system during countdown and in-flight operation. Except for gyro heater monitoring, which begins immediately on receipt at the operational base, this series of operations begins on receipt of the missile at the RIM building. Figure 10-8 illustrates the sequence of these operations and functions.

10-23. RIM BUILDING.

10-24. Figure 10-8 illustrates the sequence of RIM building operations through the guidance system bench repair shop area functional checkout. A guidance set is received in the RIM building installed in a missile. This discussion will deal entirely with guidance sets which are received installed in missiles, rather than with sets or components stored as spares.

10-25. VISUAL INSPECTION. Immediately upon receipt of a missile in the missile maintenance area, a complete visual inspection of the guidance system is performed by guidance system personnel. This inspection includes a check of the guidance set, the guidance compartment and its access doors and covers, and monitoring of the gyro heater power supply changeover from the missile gyro heater power pack to RIM building wall power.

10-26. REMOVAL OF GUIDANCE SYSTEM FROM MISSILE. After the visual inspection has been completed, the guidance set is removed from the missile. This operation involves the use of maintenance platforms, an installation and removal fixture, overhead crane, ST-137 sling, platform carrier and heater power supply, and a carrier for the control group.

CAUTION

In any operation involving transfer of the source of gyro heater power, the total time that gyros are without heater power should not exceed 5 minutes. Serious damage to gyros may result if they are without heater power for a longer period.

10-27. TRANSPORT TO BENCH REPAIR SHOP AREA. The guidance set components are transported to the guidance system bench repair shop in their respective carriers. It is important that gyro heater power be monitored during transport. Care must also be exercised to prevent damage to the equipment from collision or upset.

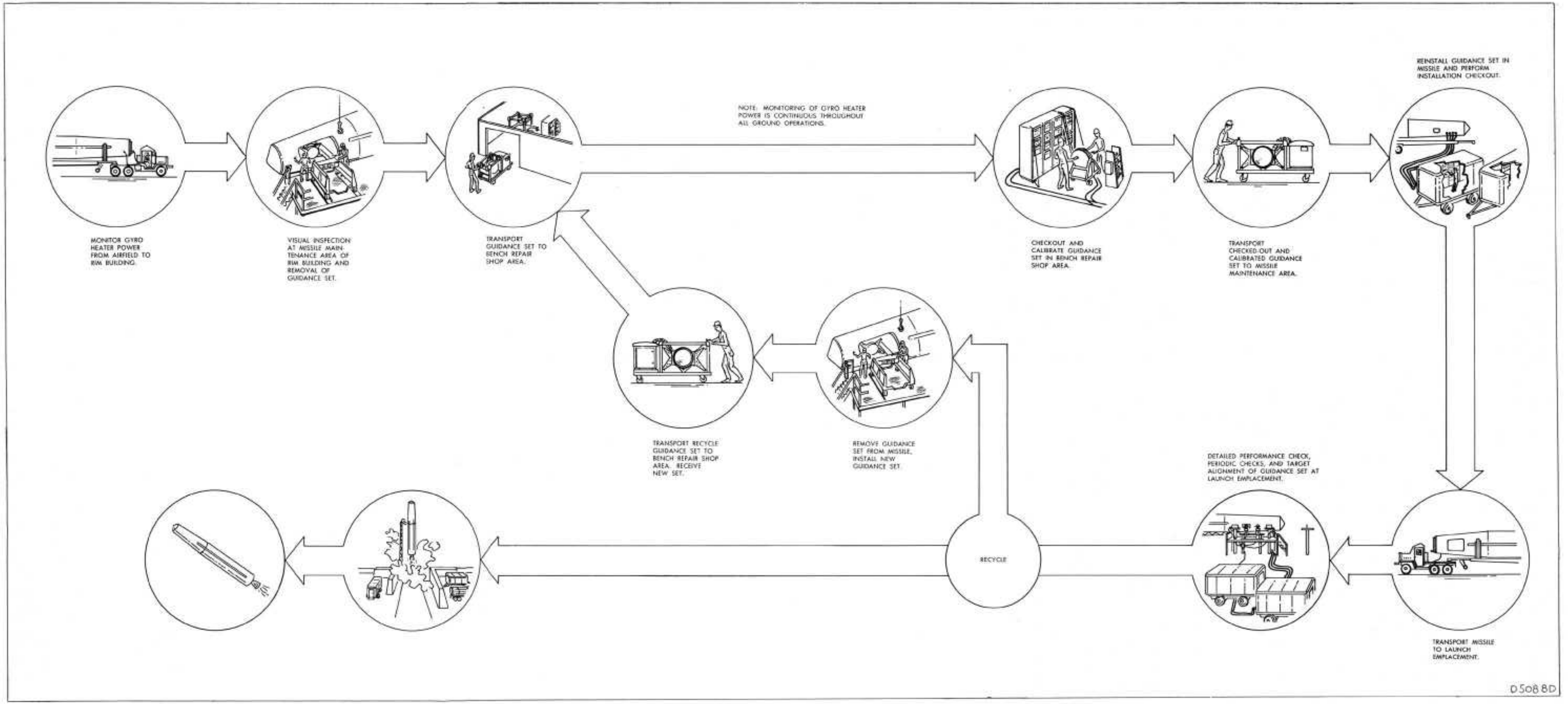


Figure 10-8. Sequence of Guidance System Operations

10-28. FUNCTIONAL CHECKOUT AND CALIBRATION. At the bench repair shop, the stabilized control group is fitted with the amplifier bracket and control group supports. The gyro heater power source is transferred to test ground support equipment. The alignment console and the interconnection checkout console are connected to the guidance set. The short range electrotheodolite, tripod mounted, is set up. Calibration and functional checkouts of the system are effected at this point. Calibration procedures are aimed primarily at setting target values into the guidance system. Any malfunction which is discovered during the functional checkout can be dealt with using the test equipment available in the bench repair shop area.

10-29. The functional checkout procedure is used in the bench repair shop area, missile maintenance area, and at the launch site. This series of checkouts is designed to indicate whether or not the guidance set is capable of maintaining a stable inertial reference for the measurement system and if the measurement system and computer can function accurately.

10-30. The stabilized platform contains torque motor and synchro arrangements which can be made to position the gimbals and platform manually by using ground support equipment or automatically by using an electrotheodolite and the vertical sensing element.

10-31. During checkout procedures, the gimbals and inertial platform are driven to positions that correspond to the positions to which they will be aligned when they are set to the target azimuth at the launch emplacement. The stabilization subsystem operates to maintain this relative position. After it is proved that the guidance set functions properly, it is transported back to the missile and reinstalled.

10-32. TRANSPORT TO MISSILE MAINTENANCE AREA. The operations involved in transporting the guidance set back to the missile maintenance area for reinstallation in the missile are essentially the same as those necessary to transport it to the bench repair shop area. Gyro heater power must be monitored continuously.

10-33. REINSTALLATION OF GUIDANCE SET IN MISSILE. The operations involved in reinstalling the guidance set in the missile are essentially the reverse of those necessary to remove the guidance set. The changeover of the source of heater power must be effected in accordance with the CAUTION note preceding (paragraph 10-27). Heater power monitoring is continuous.

10-34. PREPARATION FOR CHECKOUT. The guidance system must be prepared for a functional checkout (figure 10-9) after its installation in the missile. The alignment set mounted in the missile launching simulator is used as ground support equipment in this operation. The guidance test set located in the missile checkout station is available for use in troubleshooting procedures which may have to be used during the functional checkout.

10-35. MISSILE MAINTENANCE AREA FUNCTIONAL CHECKOUT. Using the ground support equipment illustrated in figure 10-9, a complete functional checkout of the guidance set is accomplished. This checkout is similar to the checkout performed in the guidance bench repair shop area. It is designed to prove repeatability of performance obtained in the bench repair shop area after reinstallation of the equipment in the missile.

10-36. TRANSPORT TO LAUNCH EMPLACEMENT. After it is certain that the guidance set will repeat guidance bench repair shop area performance, the guidance system is prepared for transportation to the launch emplacement in the missile. Gyro heater power is transferred to the source to be used during transport and monitored continuously.

10-37. LAUNCH EMPLACEMENT.

10-38. The operations at the launch emplacement are calculated to bring the guidance system to readiness and insure that it remains in this condition. When readiness is reached, periodic checkouts are made until the missile is either launched or the guidance system is recycled.

10-39. RECEIPT AT LAUNCH EMPLACEMENT. When the missile is received at the launch emplacement, guidance system personnel monitor the changeover of the source of gyro heater power. After all equipment connections are made, preparations are made for initial target alignment and functional checkout. Gyro heater power monitoring is continuous at the launch emplacement.

10-40. PERIODIC FUNCTIONAL CHECKS. A simulated countdown procedure, including a computer problem check, is performed daily on the guidance set. After 15 days, a detailed guidance system performance check and the alignment of the long and short range electrotheodolites are performed.

10-41. RECYCLE. Periodically, the guidance set will be removed and replaced with a guidance set that has met all performance requirements at the guidance system bench repair shop area. The guidance set that has been removed from the missile will be returned to this area for checkout, troubleshooting, and any necessary maintenance.

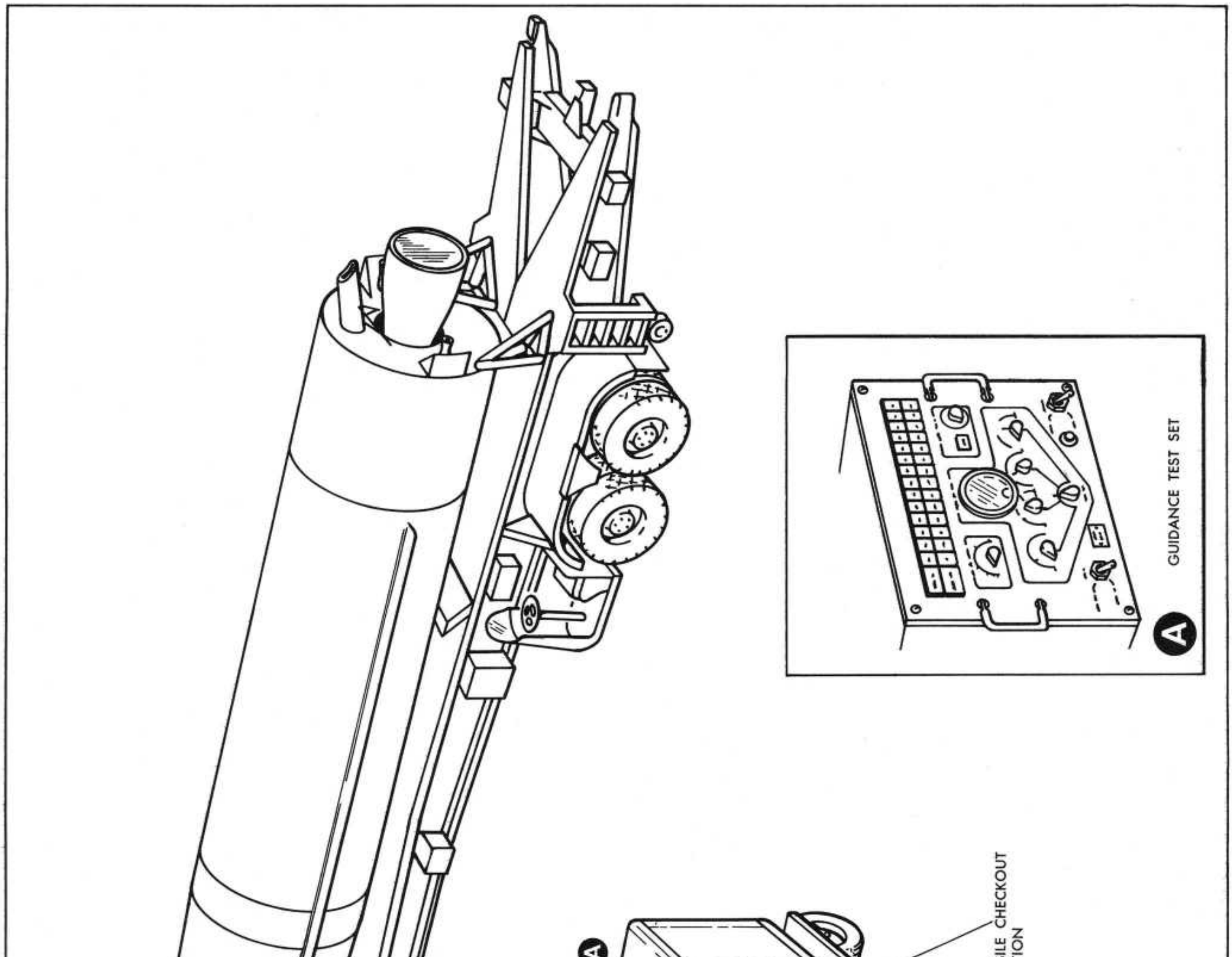


Figure 10-9. Missile Maintenance Area Functional Checkout Equipment

10-42. LAUNCH.

10-43. The guidance system normally operates at readiness in the STANDBY mode of operation. (A power-off condition can be established when the guidance set is being repaired or replaced.) If a missile is to be launched, the guidance system must be advanced through five further modes. During these modes, the inertial platform is progressively brought into fine alignment with the target azimuth. This fine alignment is accomplished using the ground support equipment illustrated in figure 10-6.

10-44. If at any time after the missile has been erected to the vertical position and a hold in the countdown is called, the guidance system must be returned to the ALIGN STEP 2 mode of operation. At this time the long range electrotheodolite is brought into operation.

10-45. AIRBORNE.

10-46. IN-FLIGHT STABILIZATION OPERATION. Figure 10-10 illustrates the data flow within the stabilization subsystem while the missile is in flight. The stabilization gyros sense errors in position of the platform and send this information in the form of electrical signals to the AM-1744 amplifier in the control group. The signals are amplified and sent to the PU-424 motor-generator. This component controls the power inputs to the torque motors which position the gimbals to overcome errors sensed by the gyros.

10-47. The inertial platorm is originally aligned in a position defined as follows:

a. The plane described by the X and Y axes oriented to include the local gravity vector as indicated by the stabilized platform vertical sensing element, and the guidance reference azimuth.

b. The Z axis established perpendicular to the X-Y plane. The Z axis is described as pointing in the right-hand direction looking downrange.

Note

The guidance reference azimuth is measured at the launch site, in a clockwise direction from true north, to a direction vector passing through the target position at impact.

c. When the inertial platform has been oriented properly, it provides a stable reference point from which to measure missle acceleration.

10-48. IN-FLIGHT MEASUREMENT OPERATION. Figure 10-11 illustrates the data flow within the measurement subsystem while the missile is in flight. The inertial platform contains three gyro accelerometer assemblies which are mounted so that each is sensitive to acceleration in one of the three intersecting planes which contain the platform axes.

10-49. Acceleration values sensed by the accelerometers are sent to the CP-372 computer where they result in error signals. These error signals are amplified in the AM-1744 amplifier and sent back to the CP-372 computer where they are used to drive the wiper arms of velocity-to-be-gained potentiometers.

10-50. The continually changing velocity-to-be-gained signal is taken from the potentiometer wiper arms and amplified in the AM-1744 amplifier. The amplifier signal is then sent to the AM-1745 amplifier where it is multiplied by the Q constants. The Q constants are inserted into the guidance set in the form of potentiometer settings. The Q values, representing a constant correction factor for all conditions which effect missile flight, are sent to the accelerometers.

10-51. It is from this loop that the yaw and pitch steering command signals and engine cutoff signals are taken. The prearm signal generation system also makes use of data from this loop.

10-52. IN-FLIGHT GENERATION OF YAW AND PITCH STEERING COMMAND SIGNALS. The accelerometers and the entire measurement system are operative from the instant of launch. The signals developed by the measurement system are not utilized until after the first portion of the powered flight is completed. After this time the flight control system utilizes the steering signals to control direction of engine thrust so that the missile will accelerate along a vector which will bring the velocity-to-be-gained in all directions to zero. When the velocities-to-be-gained are zero, the missile is said to be at correlated velocity.

10-53. The accelerometers each transmit a signal that corresponds to the rate of change in velocity-to-be-gained in the direction in which they are sensing acceleration. These signals are amplified in the AM-1744 amplifier and sent to the CP-372 computer where they are added to the values of velocity-to-be-gained that are present as a result of the measurement system operation described in paragraphs 10-46 through 10-49.

10-54. The guidance system in-flight operations are concluded upon the delivery of the engine cutoff and prearm signals.

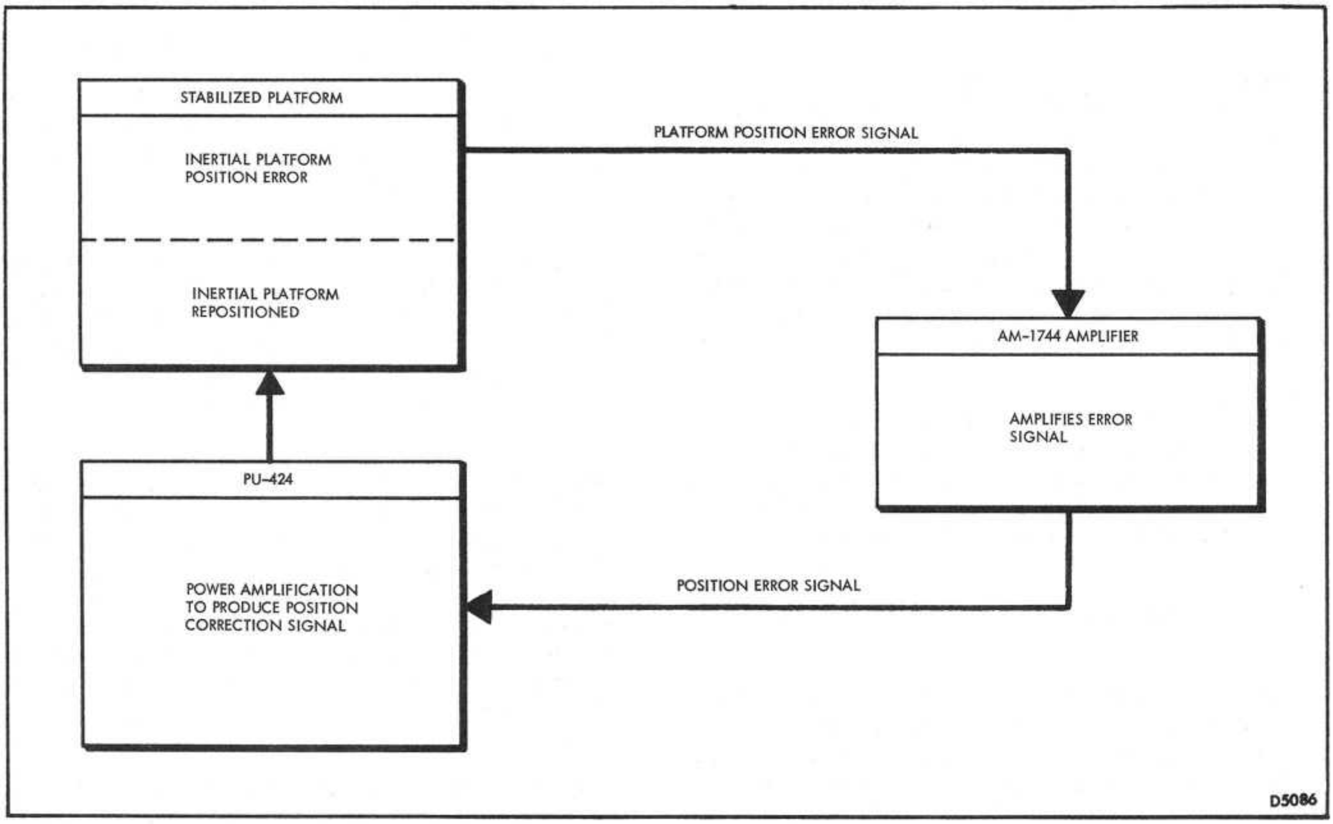


Figure 10-10. Components Used in In-Flight Stabilization of Inertial Reference

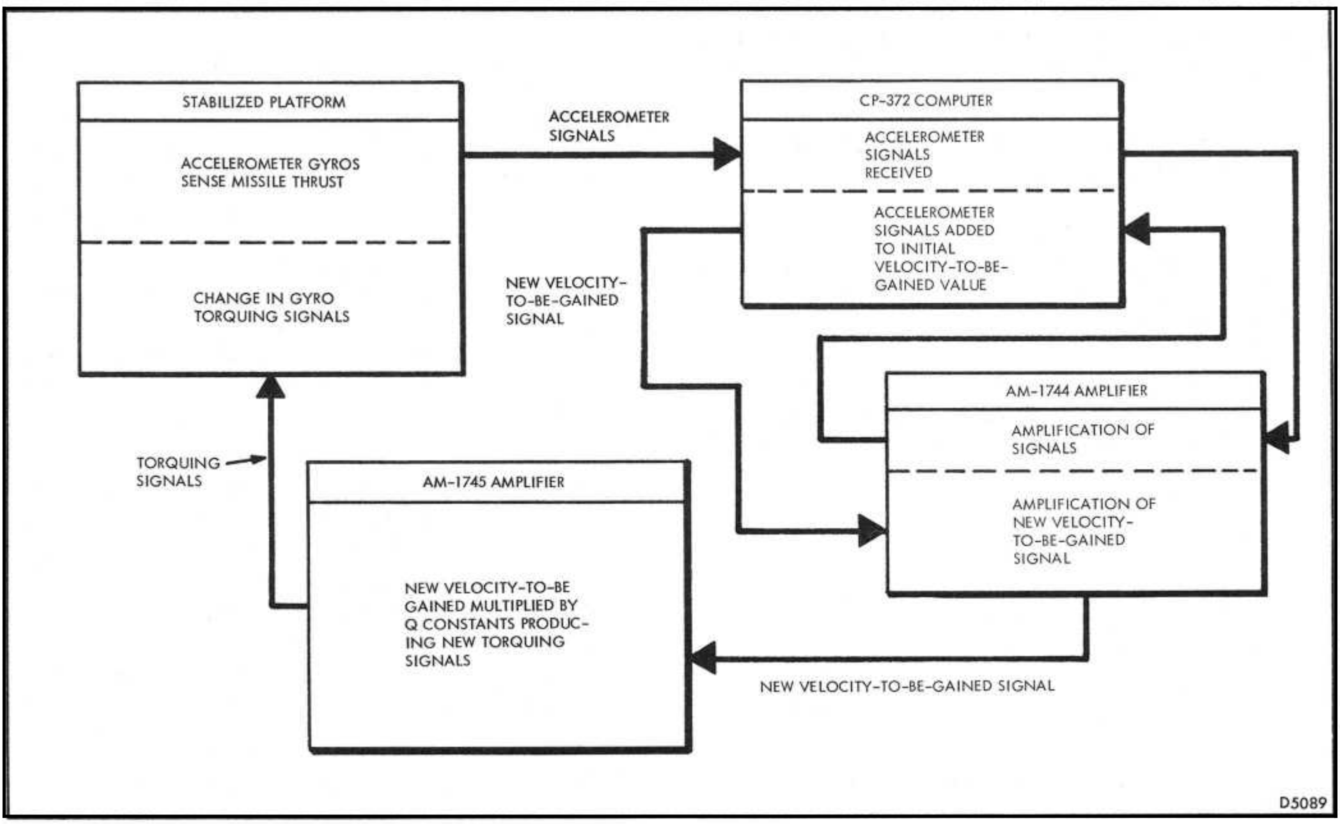


Figure 10-11. Components Used in In-Flight Operation of Measurement System

SECTION XI

RE-ENTRY VEHICLE

Note

This information is classified secret. Refer to job operation manual Re-entry Vehicles, AF/A37E-1 (XC-1A) and -2 (XC-2A), Surveillance and Inspection Building and function manual Re-entry Vehicles, AF/A37E-1 (XC-1A) and -2 (XC-2A).

GLOSSARY

Anti Vortex	Prevents whirlpool effect when transferring fuel.
Ballistic Trajectory	The curved flight followed by a projectile to its target.
Boiloff	Liquid oxygen evaporation.
Checkout/Exercise Condition	Weapon configuration for exercise countdown, also for some subsystem checks.
Engine Cutoff	The closing of the main propellant valves in a liquid propellant engine.
HIG	Hermetically sealed, integrated gyro.
Launching Control Group	See Trailer-Mounted Launching Control Group A/M24A-2.
Launching Countdown Group	See Trailer-Mounted Launching Countdown Group A/M24A-1.
Maintenance Condition	Weapon configuration for repair or recycle maintenance of a subsystem.
Main Ignition	The start stage of combustion in a liquid propellant rocket engine prior to turbopump and mainstage.
Missile Bottles	Spherical steel reservoirs for storing nitrogen gas, located in the engine and accessories section.
Missile Checkout Station	See Trailer-Mounted Ballistic Missile System Checkout Station TTU-92/M.
Officer Launch Console	A console which provides information about, and certain controls over, the three missiles of a launch position. It is located in the launching control group and under the jurisdiction of the launch control officer.
PBX	Private branch exchange.
Purge	Cleansing a unit or system (fluid or pneumatic) of residual or other unwanted content and then charging the interior with a known content.
Ready Condition	The condition of a missile and its GSE when ready to begin a countdown.
Squib	A small electrically ignited explosive device used for instigating activation of a mechanical contrivance.
Standby Condition	Alternate term for ready condition.
Stratification	Tendency of fuels of dissimilar specific gravities to segregate into layers.

T	Time of launch.
T−	Starting time of countdown with the number of minutes remaining until the missile lifts off.
T+	The number of seconds that have passed since lift-off.
Tactical Hold	A manually imposed interruption of a missile launching countdown for purposes of target realignment or other tactical reasons.
Technical Hold	An automatic interruption of a missile launching countdown caused by a malfunction within the integrated system.

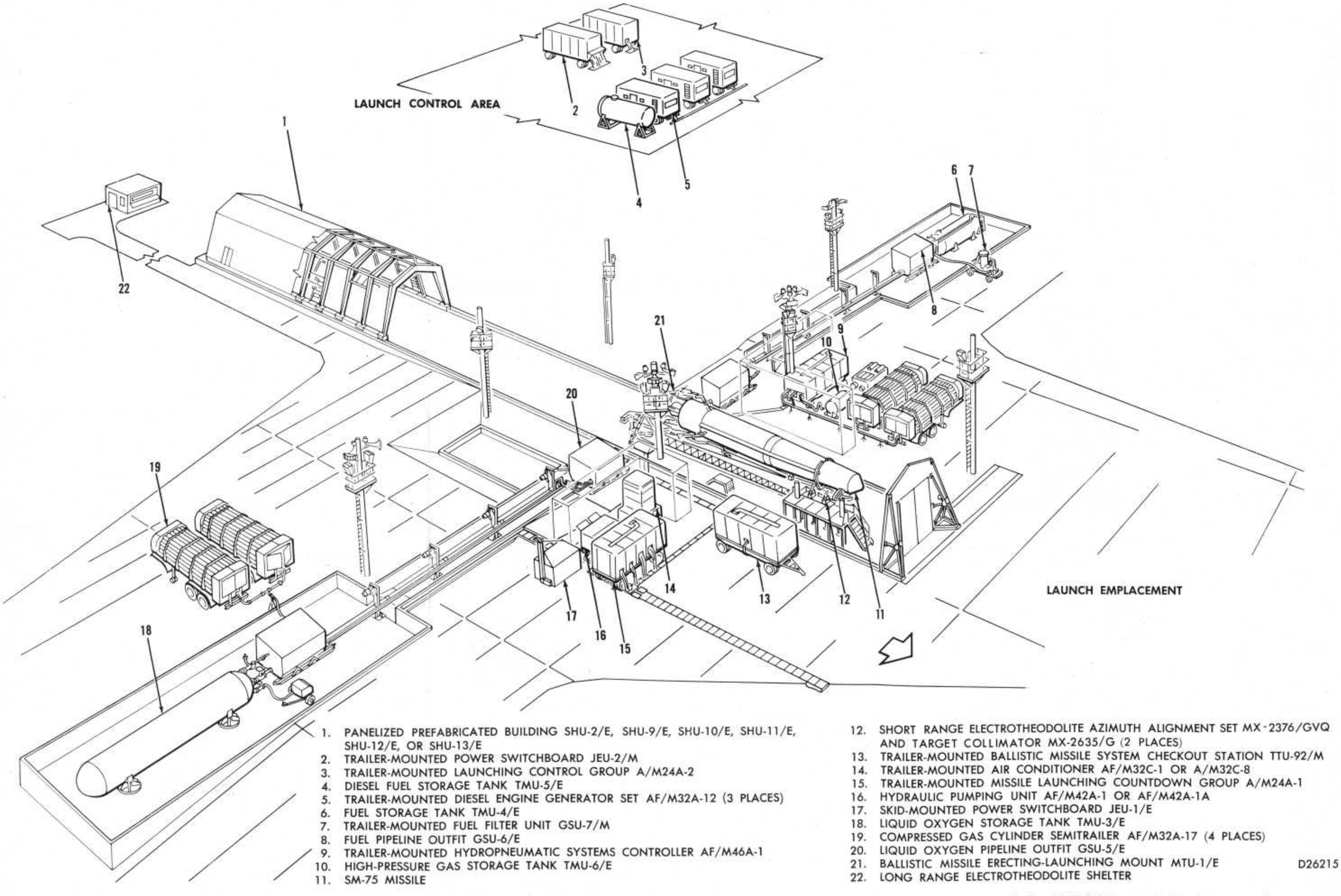
ALPHABETICAL INDEX

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Section I T.O. 21-SM75-1J-2-16-1

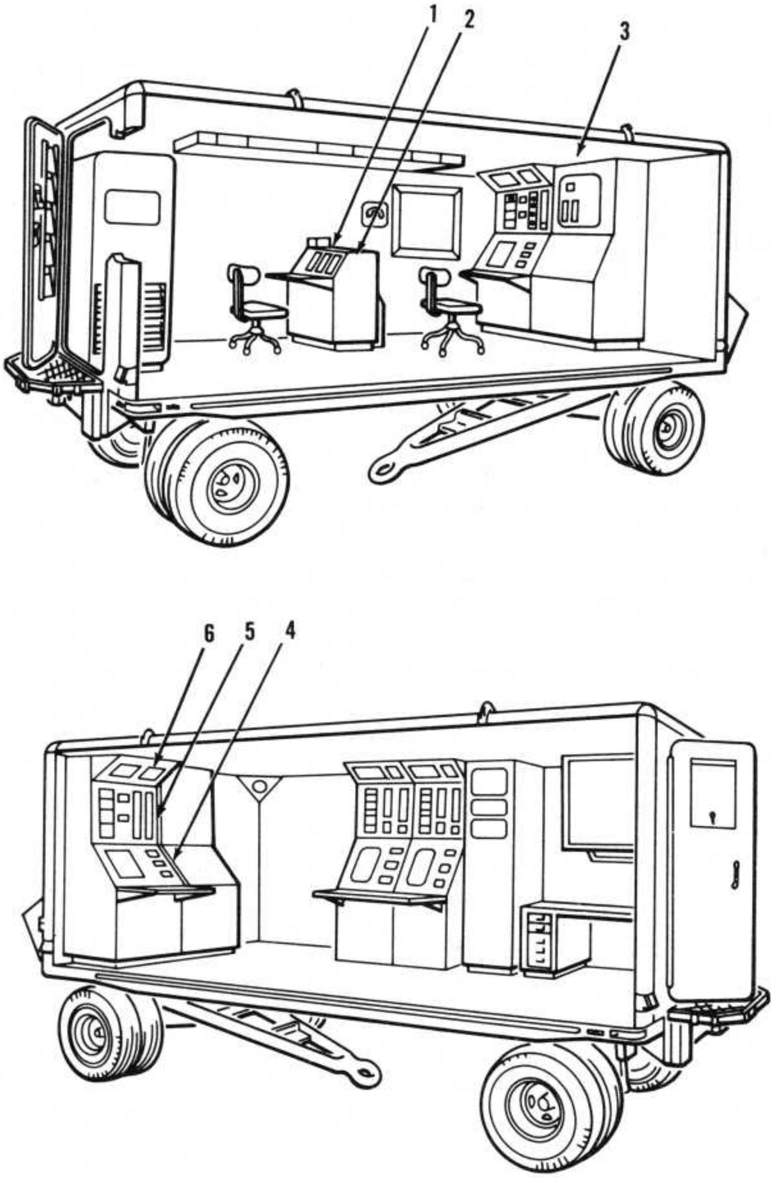


1. PANELIZED PREFABRICATED BUILDING SHU-2/E, SHU-9/E, SHU-10/E, SHU-11/E, SHU-12/E, OR SHU-13/E
2. TRAILER-MOUNTED POWER SWITCHBOARD JEU-2/M
3. TRAILER-MOUNTED LAUNCHING CONTROL GROUP A/M24A-2
4. DIESEL FUEL STORAGE TANK TMU-5/E
5. TRAILER-MOUNTED DIESEL ENGINE GENERATOR SET AF/M32A-12 (3 PLACES)
6. FUEL STORAGE TANK TMU-4/E
7. TRAILER-MOUNTED FUEL FILTER UNIT GSU-7/M
8. FUEL PIPELINE OUTFIT GSU-6/E
9. TRAILER-MOUNTED HYDROPNEUMATIC SYSTEMS CONTROLLER AF/M46A-1
10. HIGH-PRESSURE GAS STORAGE TANK TMU-6/E
11. SM-75 MISSILE
12. SHORT RANGE ELECTROTHEODOLITE AZIMUTH ALIGNMENT SET MX-2376/GVQ AND TARGET COLLIMATOR MX-2635/G (2 PLACES)
13. TRAILER-MOUNTED BALLISTIC MISSILE SYSTEM CHECKOUT STATION TTU-92/M
14. TRAILER-MOUNTED AIR CONDITIONER AF/M32C-1 OR A/M32C-8
15. TRAILER-MOUNTED MISSILE LAUNCHING COUNTDOWN GROUP A/M24A-1
16. HYDRAULIC PUMPING UNIT AF/M42A-1 OR AF/M42A-1A
17. SKID-MOUNTED POWER SWITCHBOARD JEU-1/E
18. LIQUID OXYGEN STORAGE TANK TMU-3/E
19. COMPRESSED GAS CYLINDER SEMITRAILER AF/M32A-17 (4 PLACES)
20. LIQUID OXYGEN PIPELINE OUTFIT GSU-5/E
21. BALLISTIC MISSILE ERECTING-LAUNCHING MOUNT MTU-1/E
22. LONG RANGE ELECTROTHEODOLITE SHELTER

Figure 1-1. SM-75 Launch Emplacement

Figure 1-1. SM-75 Launch Emplacement

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1. LAUNCH OFFICER MISSILE AND GENERATOR CONTROL PANELS
2. LAUNCH CONTROL CONSOLE
3. POWER DISTRIBUTION PANEL
4. LAUNCH CONTROL PANEL
5. MISSILE GUIDANCE CONTROL PANEL
6. INDICATOR PANEL

D26214

Figure 1-2. Trailer-Mounted Launching Control Group A/M24A-2

T.O. 21-SM75-1J-2-16-1 Section I

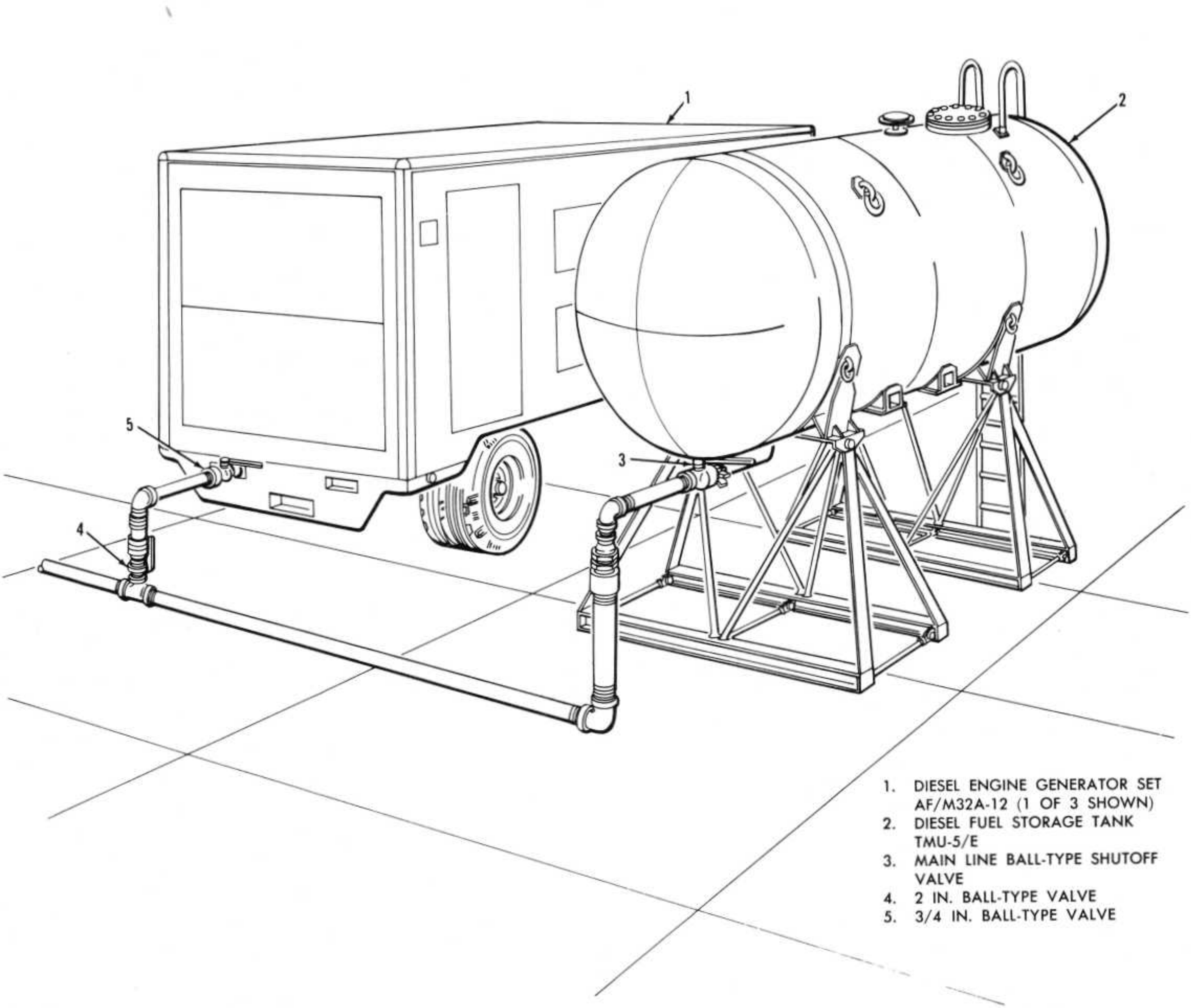
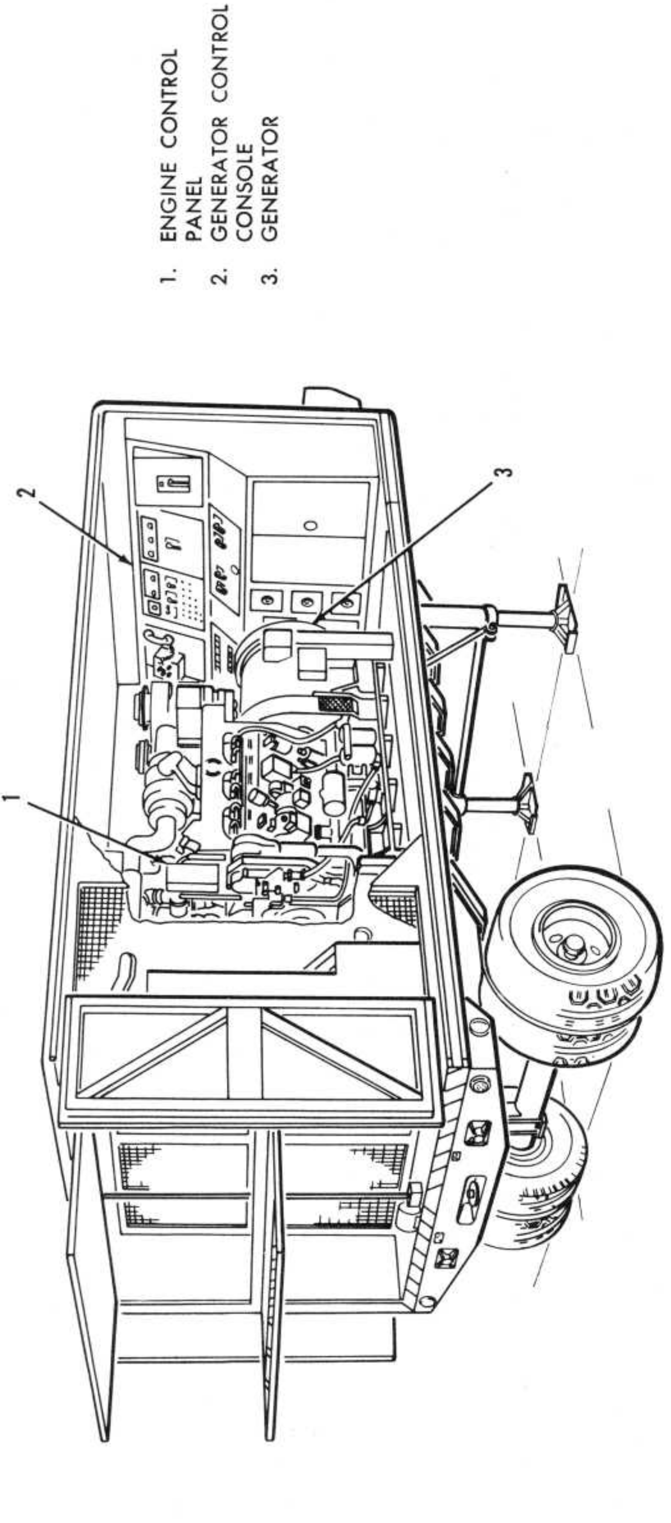


Figure 1-8. Trailer-Mounted Diesel Engine Generator Set AF/M32A-12 and Diesel Fuel Storage Tank TMU-5/E

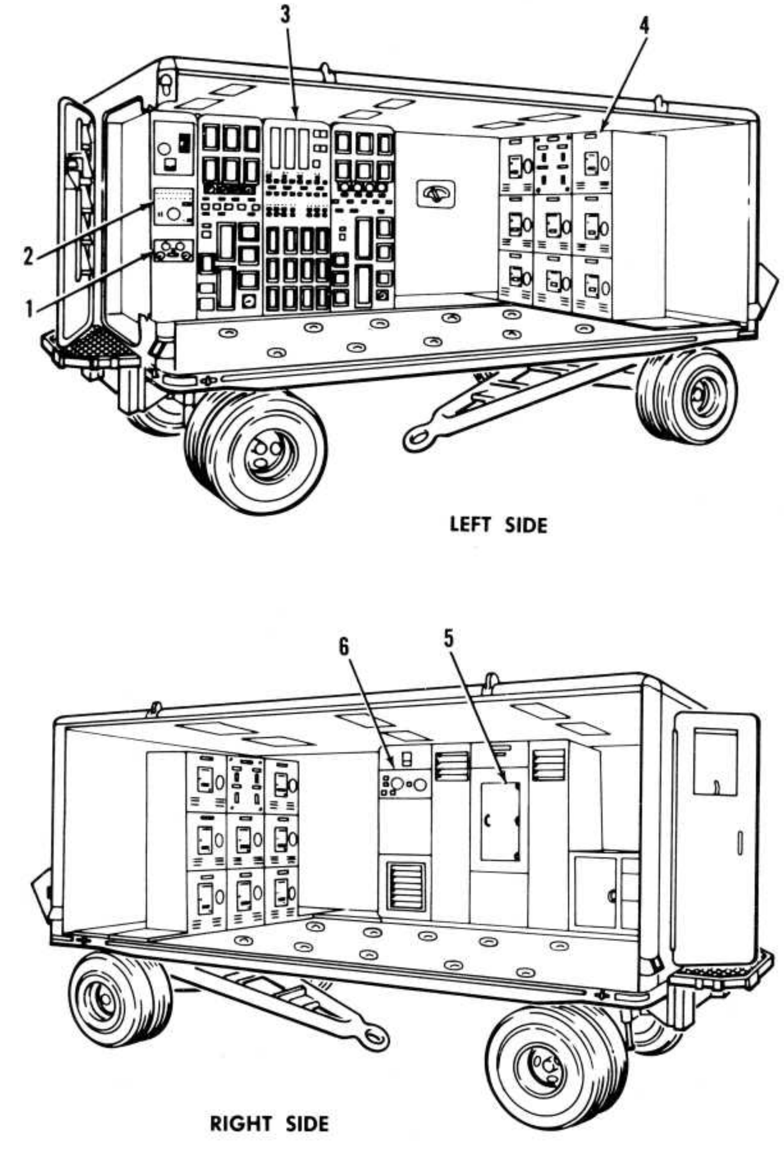
Figure 1-8. Trailer-Mounted Diesel Engine Generator Set AF/M32A-12 and Diesel Fuel Storage Tank TMU-5/E

1 November 1961 1-21



D26206

Figure 1-9. Trailer-Mounted Diesel Engine Generator Set AF/M32A-12

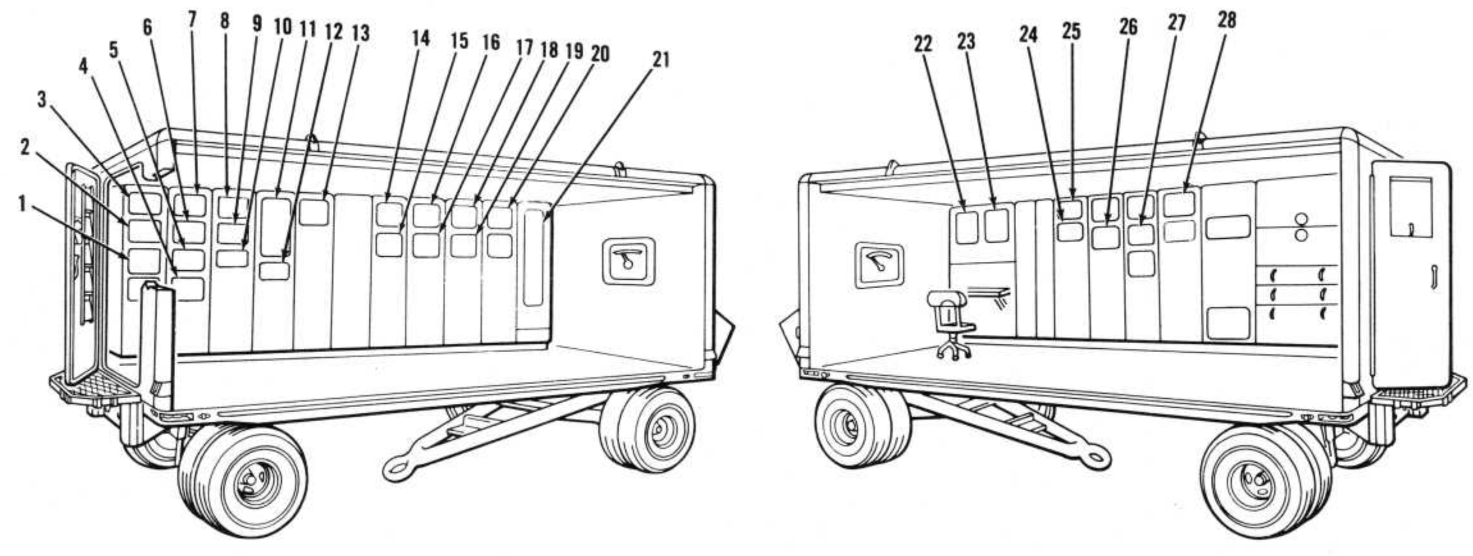


1. BATTERY CHARGER PANEL
2. BATTERY PANEL
3. ELECTRICAL SYSTEM PROTECTION PANEL
4. 480-VOLT A-C POWER DISTRIBUTION PANEL
5. 120/208-VOLT A-C POWER DISTRIBUTION PANEL
6. AIR-CONDITIONING PANEL

D26202

Figure 1-13. Trailer-Mounted Power Switchboard JEU-2/M

T.O. 21-SM75-1J-2-16-1 Section I



LEFT SIDE

RIGHT SIDE

1. RD-184 RECORDER PANEL
2. MX-2370 COUNTER PANEL
3. INDICATOR CONTROL PANEL
4. ELECTROTHEODOLITE AMPLIFIER PANEL
5. ALIGNMENT CONTROL PANEL
6. GIMBAL CONTROL PANEL
7. ACCELEROMETER CONTROL PANEL
8. AZIMUTH CONTROL PANEL
9. VELOCITY CONTROL PANEL
10. ERECTION INTEGRATOR PANEL
11. CIRCUIT BREAKER PANEL
12. CONTROL-INDICATOR LUB TANK HEATER PANEL
13. POWER CONTROL SYSTEM RELAY CHASSIS PANEL
14. MISSILE & GSE AND GUIDANCE POWER SUPPLY PANEL
15. 28-VOLT D-C MISSILE AND GSE POWER SUPPLY CONTROL PANEL
16. MISSILE BATTERY TRICKLE CHARGER PANEL
17. 28-VOLT D-C GUIDANCE POWER SUPPLY CONTROL PANEL
18. MISSILE INVERTER POWER SUPPLY PANEL
19. 28-VOLT D-C MISSILE INVERTER POWER SUPPLY CONTROL PANEL
20. TRAILER BATTERY TRICKLE CHARGER PANEL
21. POWER DISTRIBUTION PANEL
22. MISSILE AND GSE FREQUENCY CONVERTER CONTROL PANEL
23. MISSILE FREQUENCY CONVERTER CONTROL PANEL
24. 28-VOLT D-C CONTINUOUS POWER SUPPLY CONTROL PANEL
25. CONTINUOUS POWER SUPPLY PANEL
26. PROPELLANT LOADING COMPUTER PANEL
27. AUDIOFREQUENCY AMPLIFIER PANEL
28. RE-ENTRY VEHICLE PRELAUNCH MONITOR PANEL

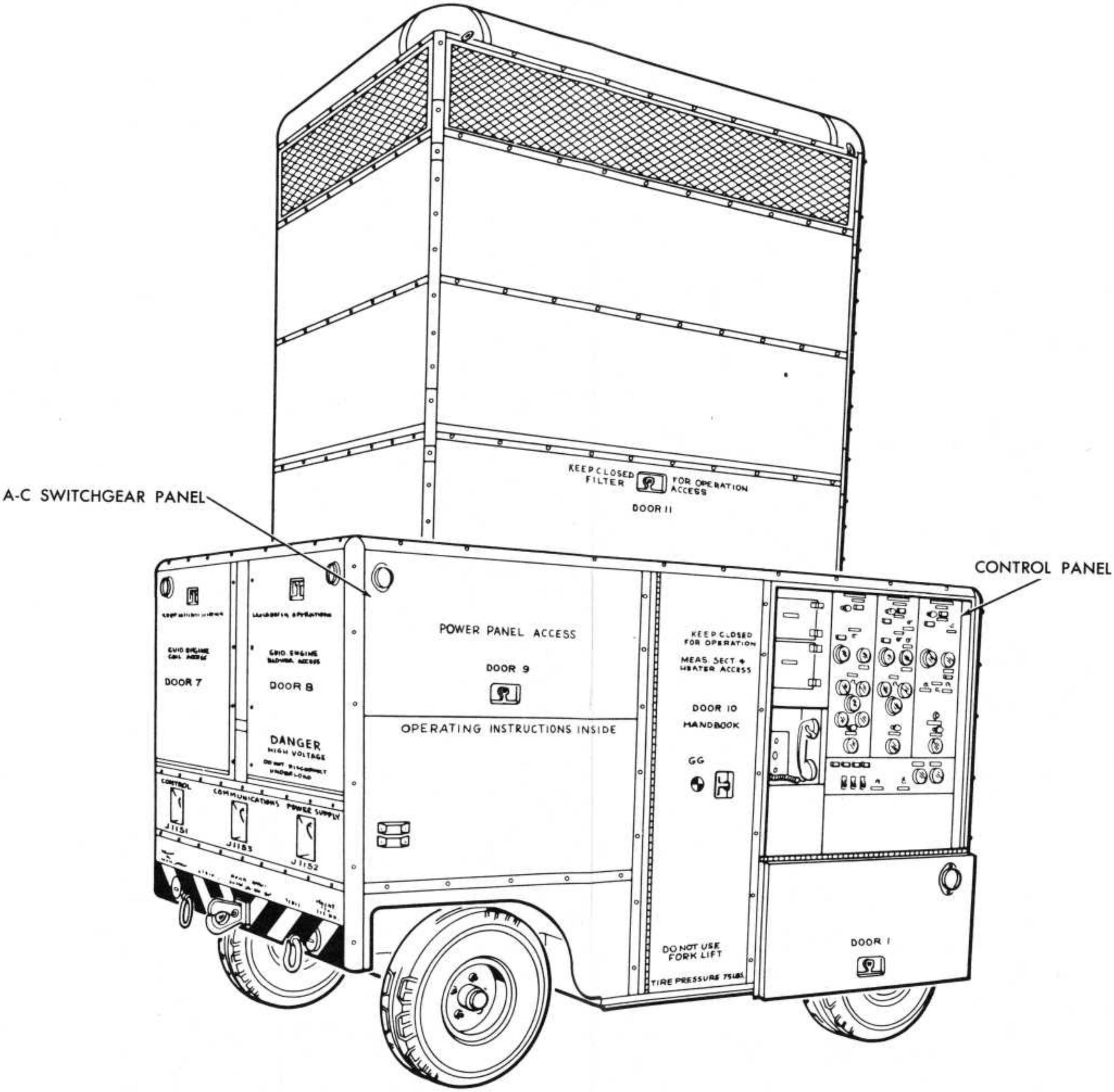
D26191

Figure 1-24. Trailer-Mounted Missile Launching Countdown Group A/M24A-1

Figure 1-24. Trailer-Mounted Missile Launching Countdown Group A/M24A-1

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T.O. 21-SM75-1J-2-16-1 Section I

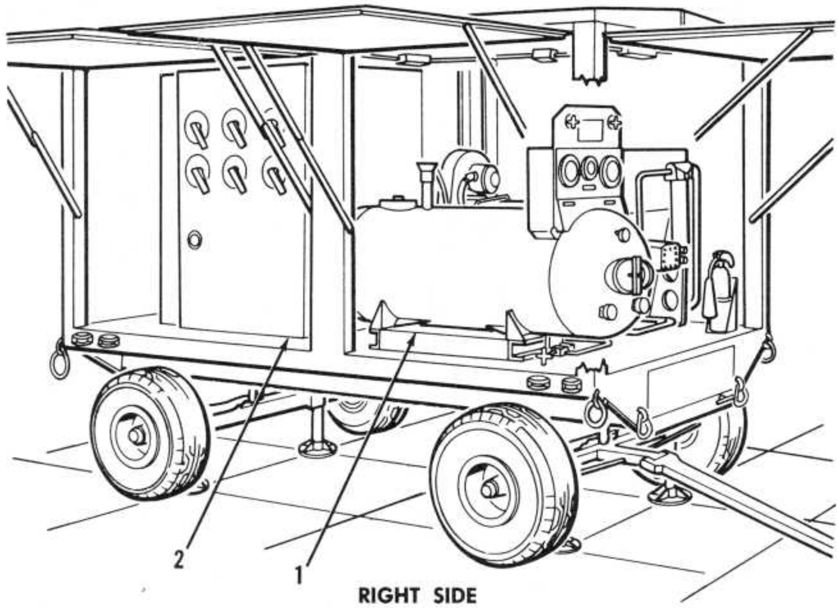


D26172

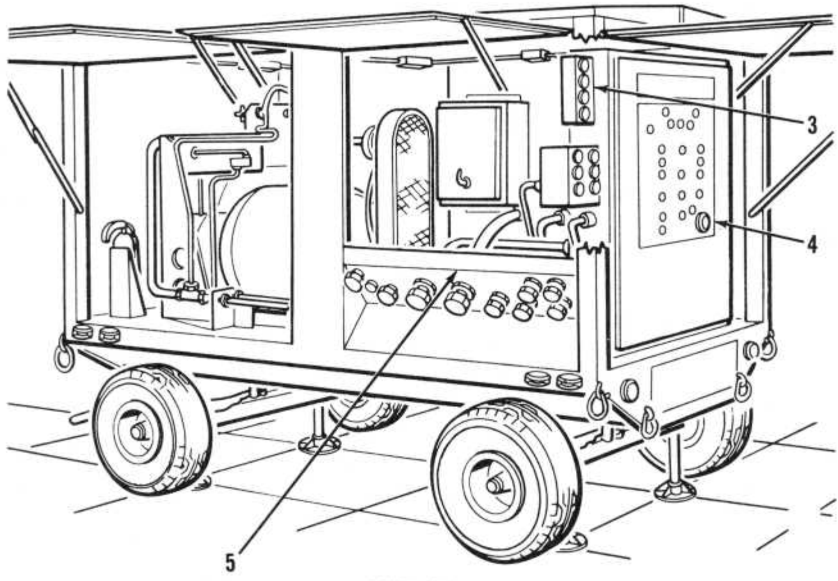
Figure 1-52. Trailer-Mounted Air Conditioner AF/M32C-1 or A/M32C-8

Figure 1-52. Trailer-Mounted Air Conditioner AF/M32C-1 or A/M32C-8

1 November 1961 1-65



RIGHT SIDE



LEFT SIDE

1. HYDRAULIC POWER UNIT
2. CIRCUIT BREAKER PANEL
3. SWITCH PANEL ASSEMBLY
4. LOCAL CONTROL PANEL
5. CONNECTOR PLATE

D27696

Figure 1-55. Hydraulic Pumping Unit AF/M42A-1 or AF/M42A-1A

1. FUEL MAST
2. LAUNCH LEG NO. 5 (TYPICAL 1 AND 3)
3. LAUNCH MOUNT LATCH (2 PLACES)
4. UMBILICAL MAST HYDRAULIC ACCUMULATOR GAGE
5. UMBILICAL MAST SELECTOR VALVE HANDCRANK
6. HYDRAULIC, PNEUMATIC, AND ELECTRICAL LINES
7. LAUNCH LEG NO. 2 (TYPICAL 4 AND 6)
8. AFT ENGINE ACCESS DOOR
9. HYDRAULIC POWER PACK ACCUMULATOR GAGE

NOTE

LAUNCH LEGS NO. 1 AND NO. 3 ARE SIMILAR TO LAUNCH LEG NO. 5. LAUNCH LEGS NO. 4 AND NO. 6 ARE SIMILAR TO LAUNCH LEG NO. 2.

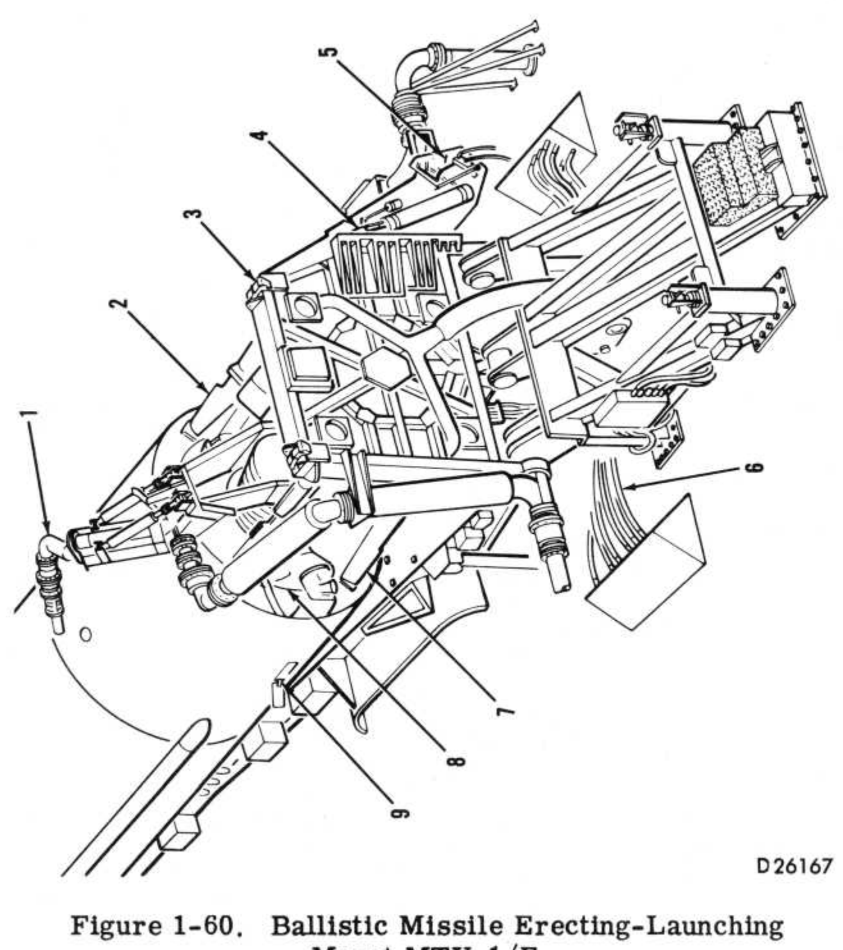
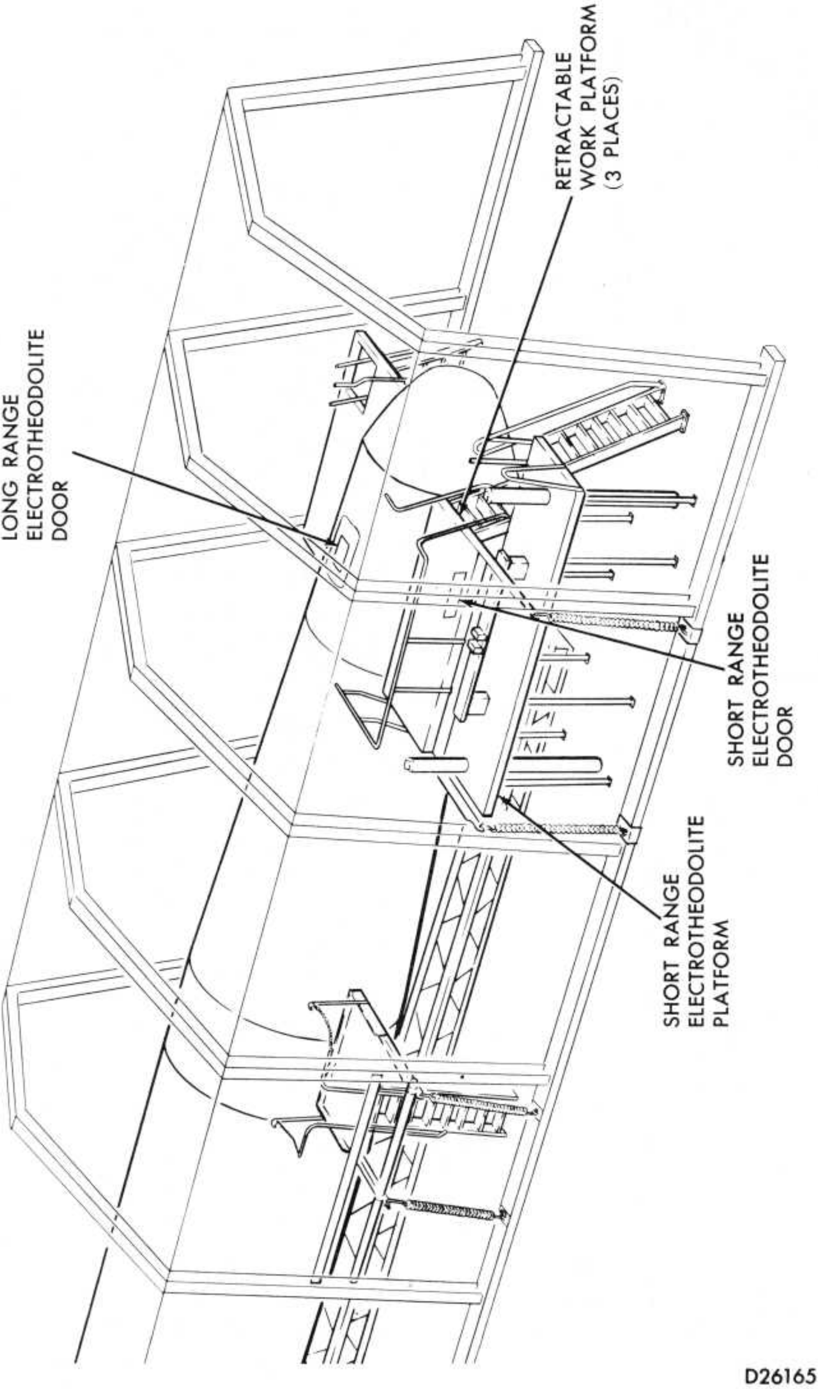


Figure 1-60. Ballistic Missile Erecting-Launching Mount MTU-1/E



D26165

Figure 1-62. Missile and Maintenance Platforms

Section I T.O. 21-SM75-1J-2-16-1

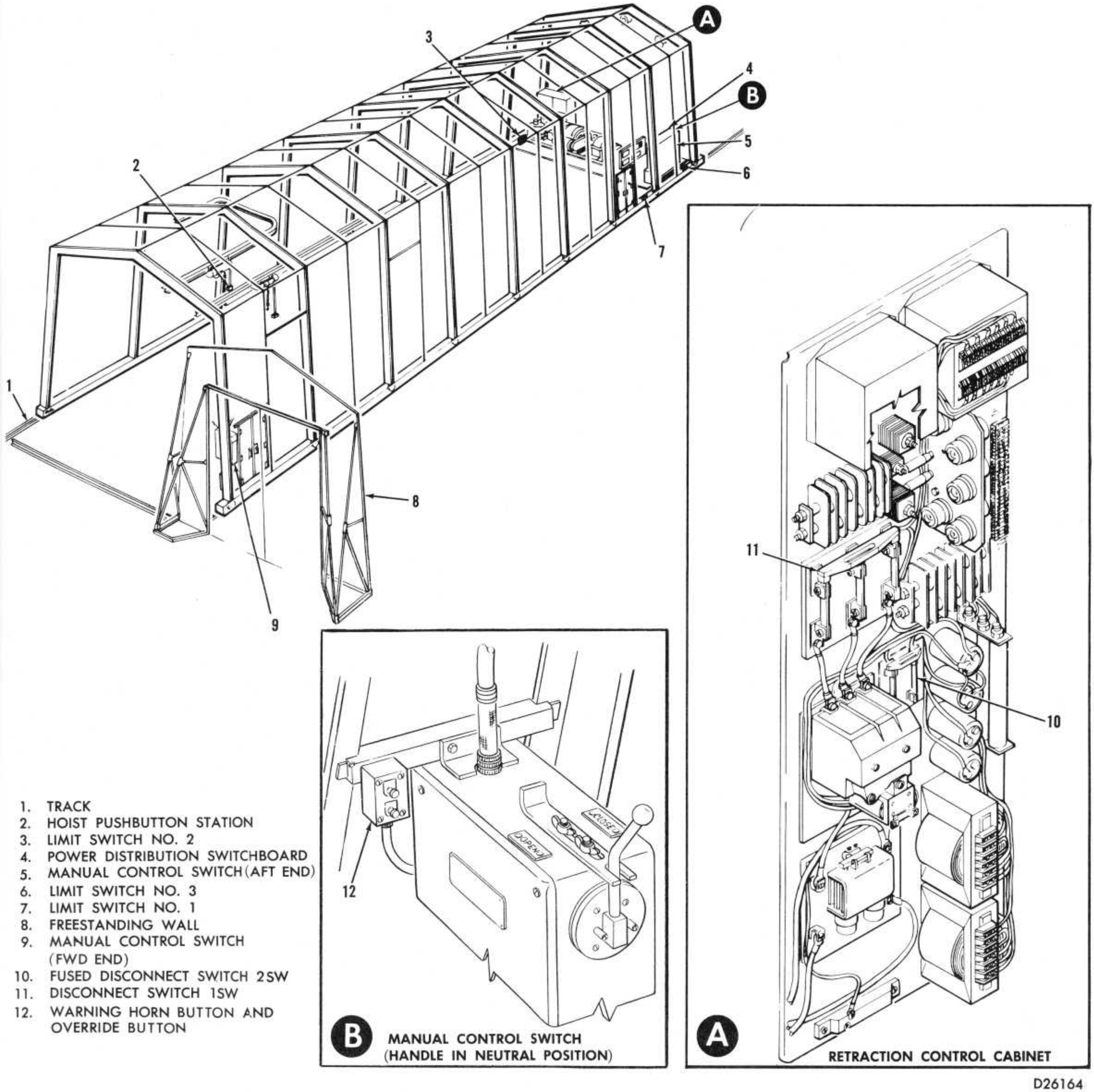


Figure 1-63. Panelized Prefabricated Building SHU-2/E, SHU-9/E, SHU-10/E, SHU-11/E, SHU-12/E, or SHU-13/E

Figure 1-63. Panelized Prefabricated Building SHU-2/E, SHU-9/E, SHU-10/E, SHU-11/E, SHU-12/E, or SHU-13/E

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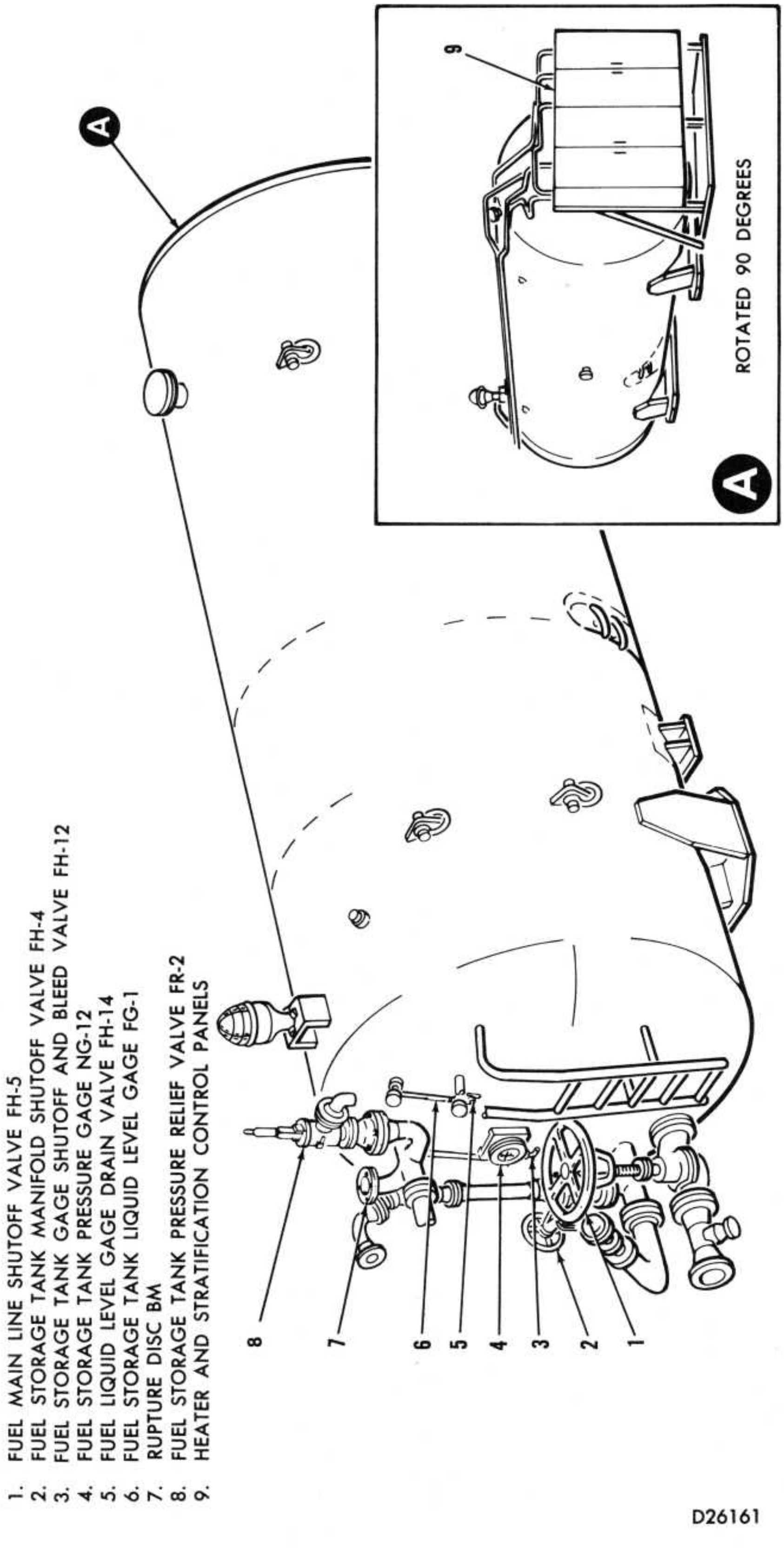
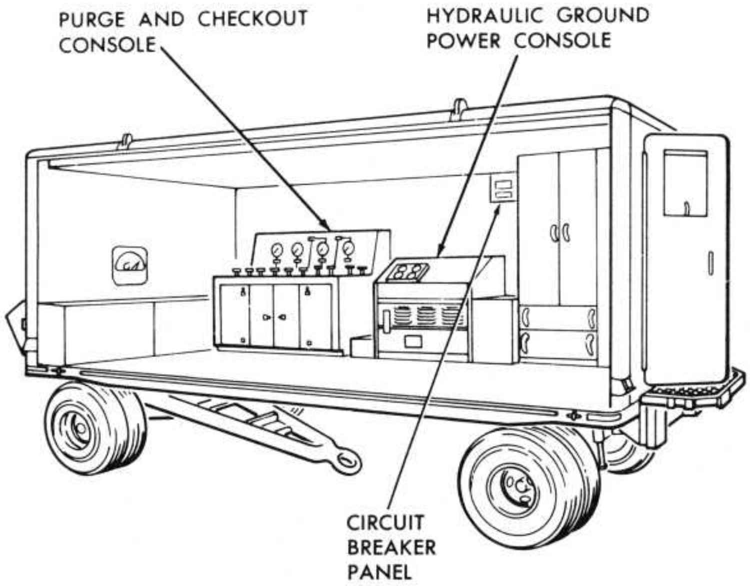


Figure 1-66. Fuel Storage Tank TMU-4/E



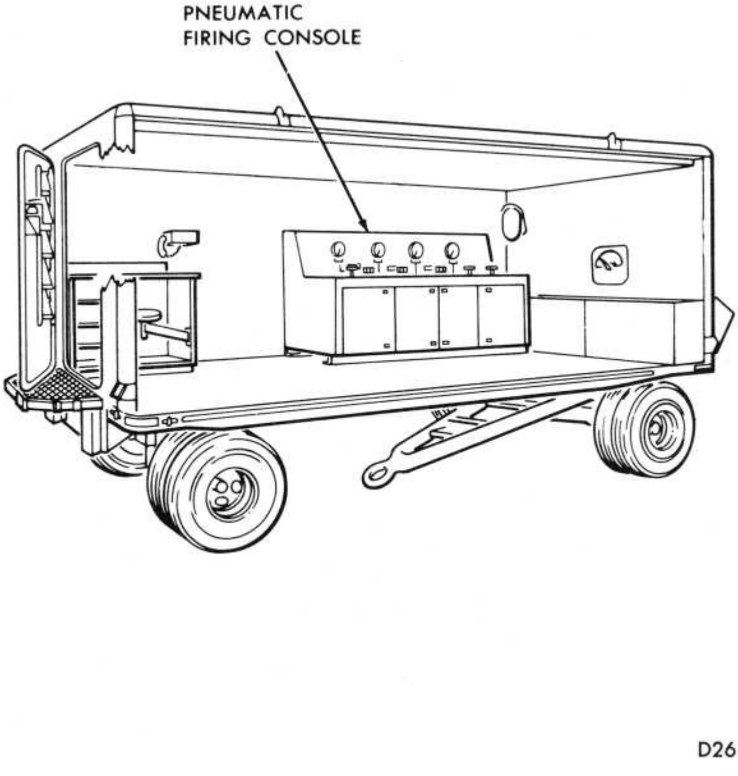
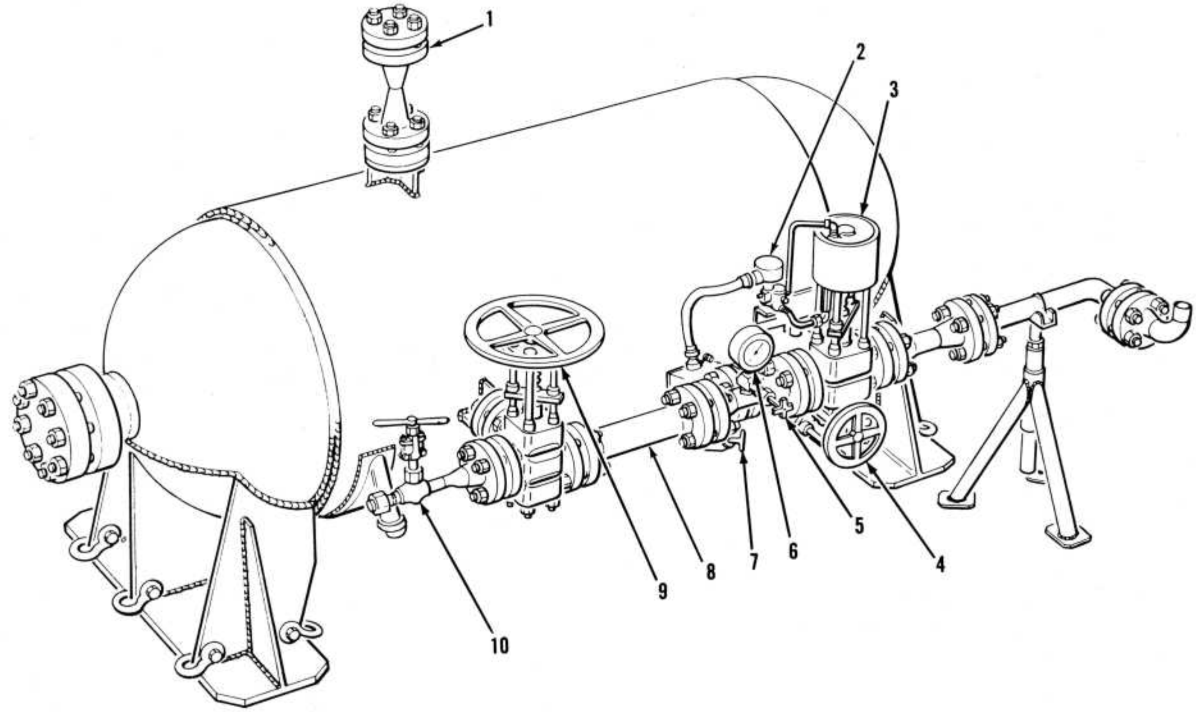


Figure 1-70. Trailer-Mounted Hydropneumatic Systems Controller AF/M46A-1

Section I T.O. 21-SM75-1J-2-16-1



1. RUPTURE DISC DD
2. MISSILE BOTTLES PRESSURIZING CONTROL SOLENOID VALVE NS-5
3. MISSILE BOTTLES PRESSURIZING VALVE NP-2
4. MISSILE BOTTLES PRESSURIZING BYPASS VALVE NH-20
5. HIGH-PRESSURE NITROGEN STORAGE TANK GAGE SHUTOFF VALVE NH-34
6. HIGH-PRESSURE NITROGEN STORAGE TANK PRESSURE GAGE NG-13
7. RE-ENTRY VEHICLE SUPPLY LINE SHUTOFF VALVE NH-30
8. HIGH-PRESSURE NITROGEN FILTER NF-3
9. HIGH-PRESSURE NITROGEN STORAGE TANK SHUTOFF VALVE NH-19
10. HIGH-PRESSURE NITROGEN STORAGE TANK FILL VALVE NH-32

D26159

Figure 1-69. High-Pressure Gas Storage Tank TMU-6/E

Figure 1-69. High-Pressure Gas Storage Tank TMU-6/E

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Section I T.O. 21-SM75-1J-2-16-1

1. NITROGEN STORAGE TRAILER SUPPLY PRESSURE GAGE NG-2
2. NITROGEN STORAGE TRAILER SUPPLY PRESSURE GAGE SHUTOFF VALVE NH-31
3. NITROGEN STORAGE TRAILER SUPPLY VALVE NH-2
4. PYROMETER BA
5. NITROGEN STORAGE TRAILER TUBE PRESSURE GAGE SHUTOFF VALVE NH-31
6. NITROGEN STORAGE TRAILER TUBE PRESSURE GAGE NG-1
7. NITROGEN STORAGE TRAILER FILL VALVE NH-2
8. NITROGEN STORAGE TRAILER FILL PRESSURE GAGE SHUTOFF VALVE NH-31
9. NITROGEN STORAGE TRAILER FILL PRESSURE GAGE NG-2
10. NITROGEN STORAGE TRAILER TUBE SHUTOFF VALVE NH-1 (TYPICAL 38 PLACES)

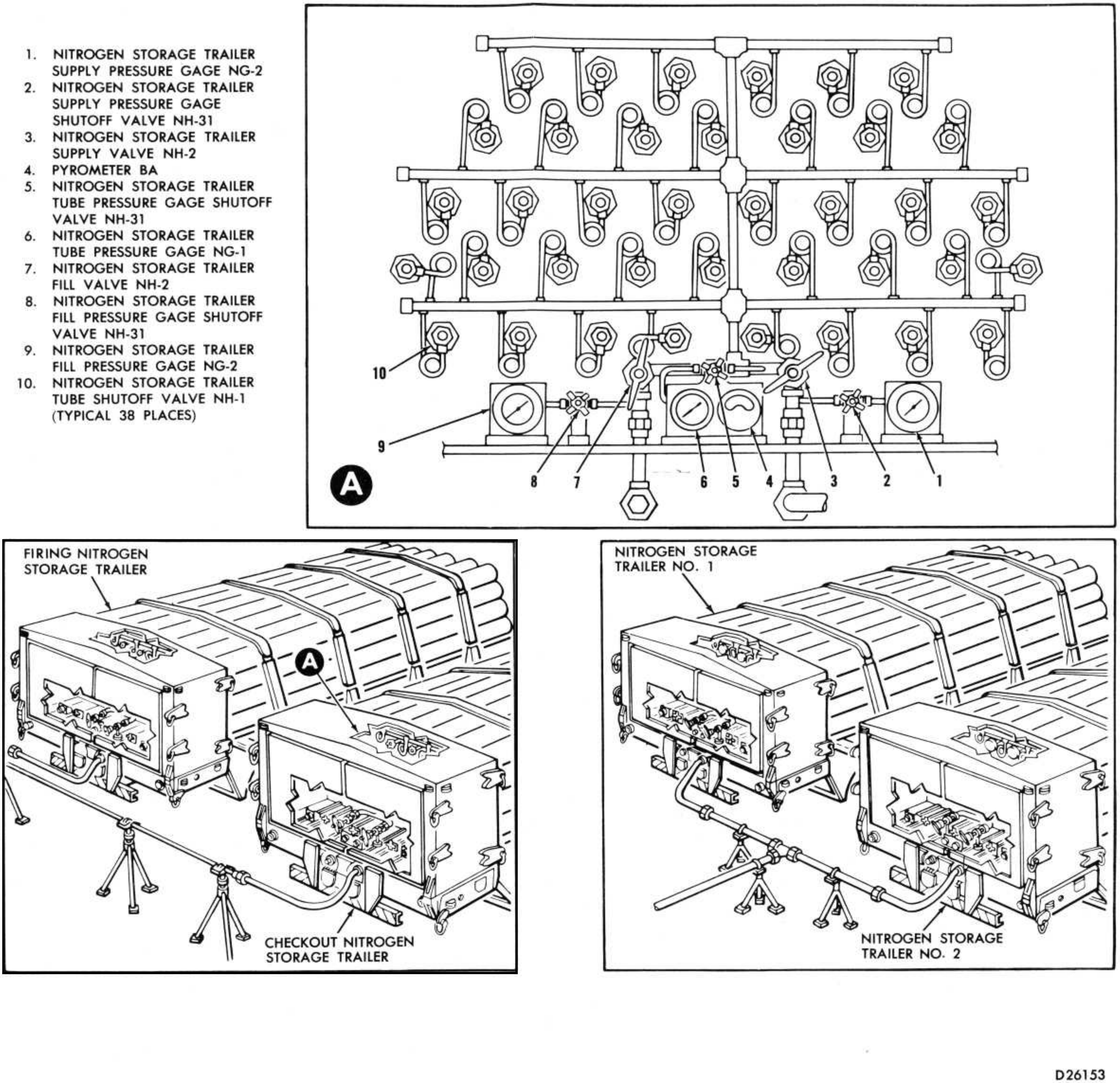
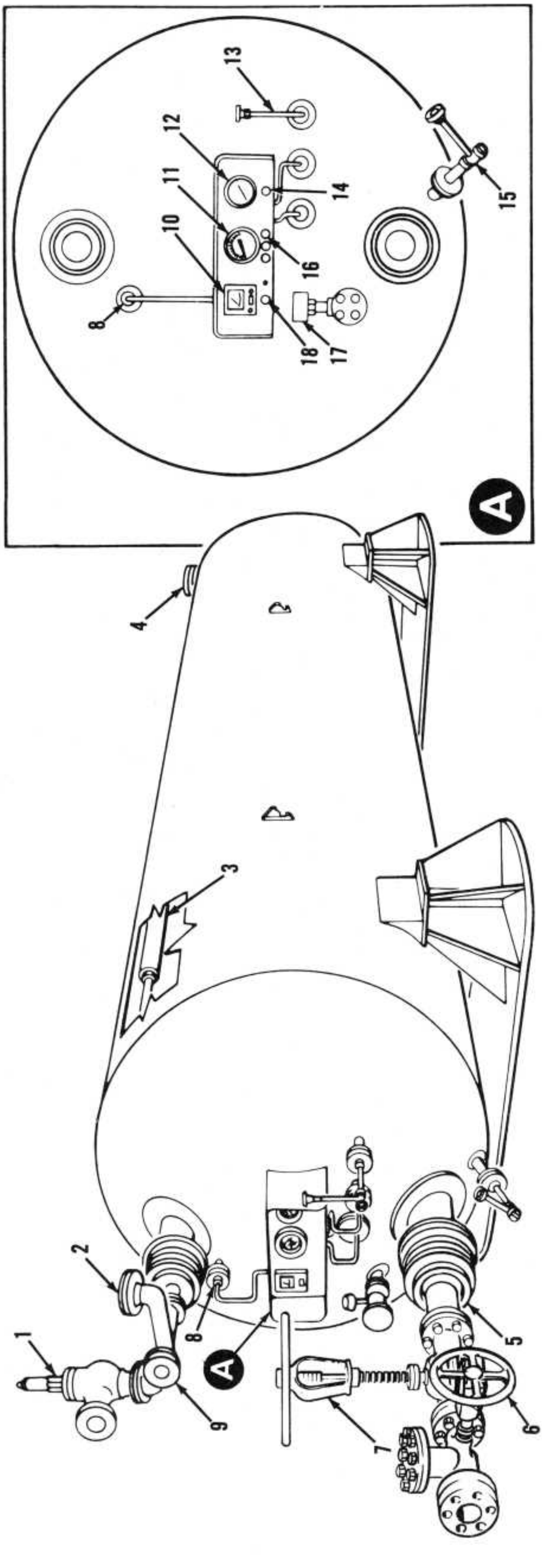


Figure 1-75. Compressed Gas Cylinder Semitrailers AF/M32A-17

Figure 1-75. Compressed Gas Cylinder Semitrailers AF/M32A-17

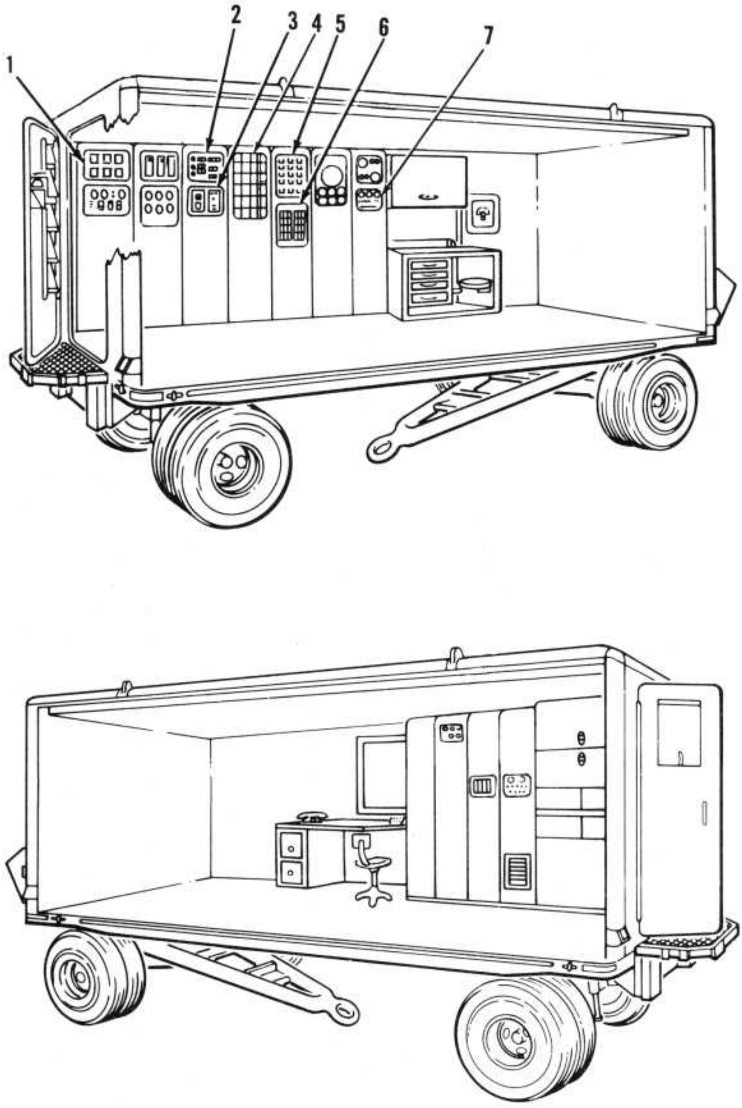
1-88 1 November 1961



1. LIQUID OXYGEN STORAGE TANK PRESSURE RELIEF VALVE OR-4
2. RUPTURE DISC DB
3. VACUUM LINE FILTER VF-2
4. LIQUID OXYGEN STORAGE TANK PRESSURE LIFT PLATE
5. LIQUID OXYGEN STORAGE TANK MAIN TRANSFER LINE FITTINGS
6. LIQUID OXYGEN MAIN LINE DRAIN VALVE LH-15
7. LIQUID OXYGEN MAIN LINE SHUTOFF VALVE LH-4
8. VACUUM GAGE FILTER VF-1
9. LIQUID OXYGEN STORAGE TANK PRESSURIZING LINE
10. LIQUID OXYGEN STORAGE TANK VACUUM GAGE VG-1
11. LIQUID OXYGEN STORAGE TANK LIQUID LEVEL GAGE LG-2
12. LIQUID OXYGEN STORAGE TANK PRESSURE GAGE LG-1
13. LIQUID OXYGEN STORAGE TANK FULL TRYCOCK LH-17
14. LIQUID OXYGEN GAGE DRAIN VALVE LH-11
15. LIQUID OXYGEN STORAGE TANK DRAIN VALVE LH-16
16. LIQUID OXYGEN STORAGE TANK LIQUID LEVEL GAGE SHUTOFF VALVE LH-2
17. VACUUM LINE SHUTOFF VALVE VH-1
18. VACUUM GAGE SHUTOFF VALVE VH-2

D26151

Figure 1-78. Liquid Oxygen Storage Tank TMU-3/E

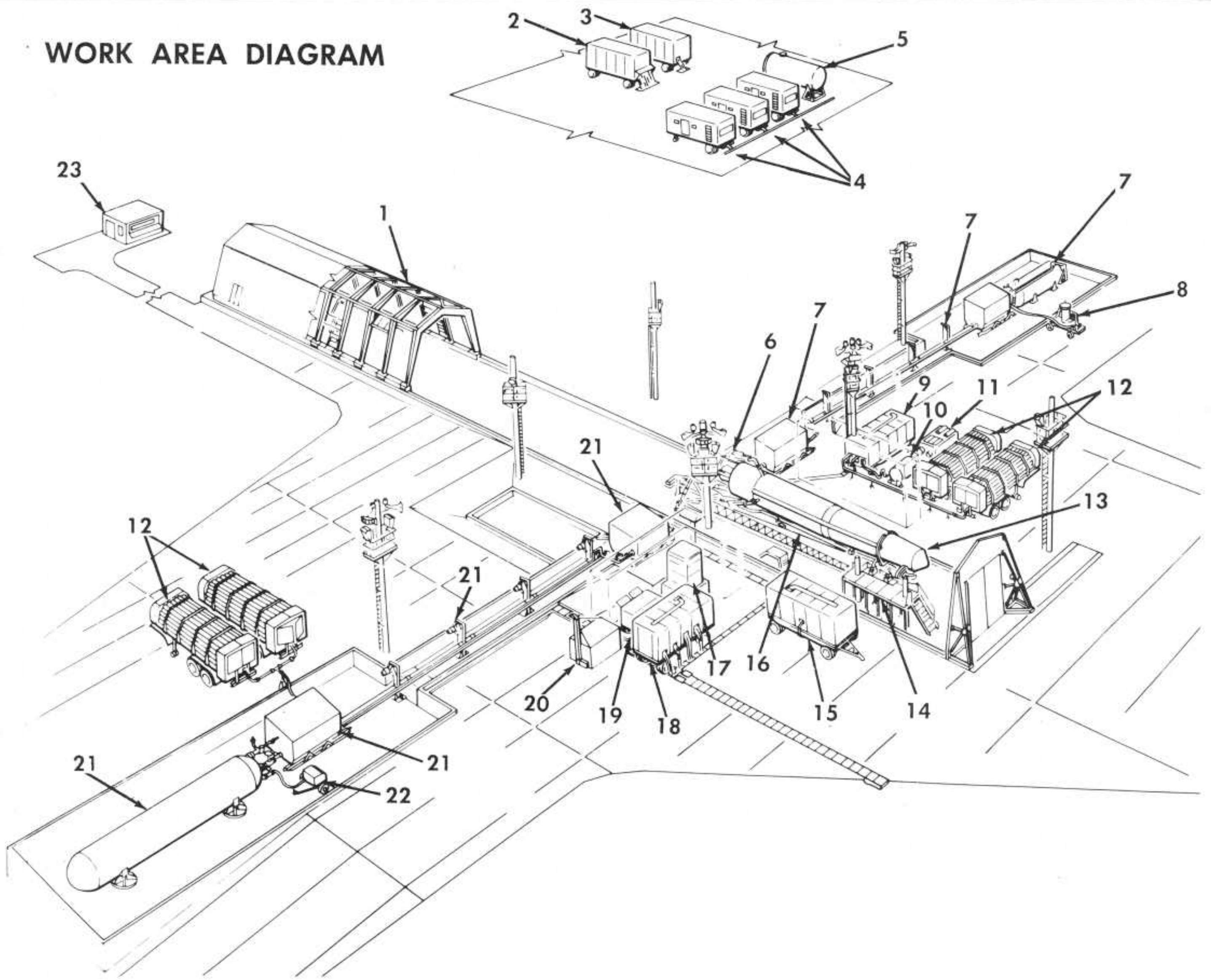


1. POWER CONTROL PANEL
2. GIMBAL CONTROL PANEL
3. PROGRAMMER PANEL
4. PROPELLANT TRANSFER SYSTEM CHECKOUT PANEL
5. ROCKET ENGINE CHECKOUT CONTROL-MONITOR PANEL
6. SIGNAL DATA RECORDER PANEL
7. CIRCUIT BREAKER PANEL

D27706

Figure 1-80. Trailer-Mounted Ballistic Missile System Checkout Station TTU-92/M

WORK AREA DIAGRAM



1. PANELIZED PREFABRICATED BUILDING SHU-2/E
2. TRAILER-MOUNTED POWER SWITCHBOARD JEU-2/M
3. TRAILER-MOUNTED LAUNCHING CONTROL GROUP A/M24A-2
4. TRAILER-MOUNTED DIESEL ENGINE GENERATOR SET AF/M32A-12*†
5. DIESEL FUEL STORAGE TANK TMU-5/E*
6. BALLISTIC MISSILE ERECTING-LAUNCHING MOUNT MTU-1A/E
7. FUEL PIPELINE OUTFIT GSU-6/E AND FUEL STORAGE TANK TMU-4/E
8. TRAILER-MOUNTED FUEL FILTER UNIT GSU-7M†
9. TRAILER-MOUNTED HYDRO-PNEUMATIC SYSTEMS CONTROLLER AF/M46A-1
10. HIGH PRESSURE GAS STORAGE TANK TMU-6/E*
11. POWER-DRIVEN RECIPROCATING COMPRESSOR A/M32A-27*†
12. COMPRESSED GAS CYLINDER SEMITRAILER AF/M32A-17 TYPICAL (2 PLACES)*†
13. SM-75 MISSILE*
14. SHORT RANGE AZIMUTH ALIGNMENT ELECTROTHEODOLITE AN/GVQ-3
15. TRAILER-MOUNTED BALLISTIC MISSILE SYSTEM CHECKOUT STATION TTU-92/M*
16. BALLISTIC MISSILE ERECTING-TRANSPORTING BOOM GSU-33/E, AND REAR DOLLY GSU-32/M
17. TRAILER-MOUNTED AIR CONDITIONER AF/M32C-1*
18. TRAILER-MOUNTED MISSILE LAUNCHING COUNTDOWN GROUP A/M24A-1A
19. HYDRAULIC PUMPING UNIT PMU-14/E
20. SKID-MOUNTED POWER SWITCHBOARD JEU-1/E
21. LIQUID OXYGEN PIPELINE OUTFIT GSU-5/E
22. TRAILER-MOUNTED VACUUM PUMP PMU-1/M†
23. LONG RANGE AZIMUTH ALIGNMENT ELECTROTHEODOLITE AN/GVQ-4

*THIS EQUIPMENT LOCATED AT THE LAUNCH EMPLACEMENT AND RIM BUILDING

†INSPECTION REQUIREMENTS ON THIS EQUIPMENT DO NOT APPEAR IN THE INSPECTION REQUIREMENTS MANUAL

T.O. 21-SM75-1J-2-13 Section I

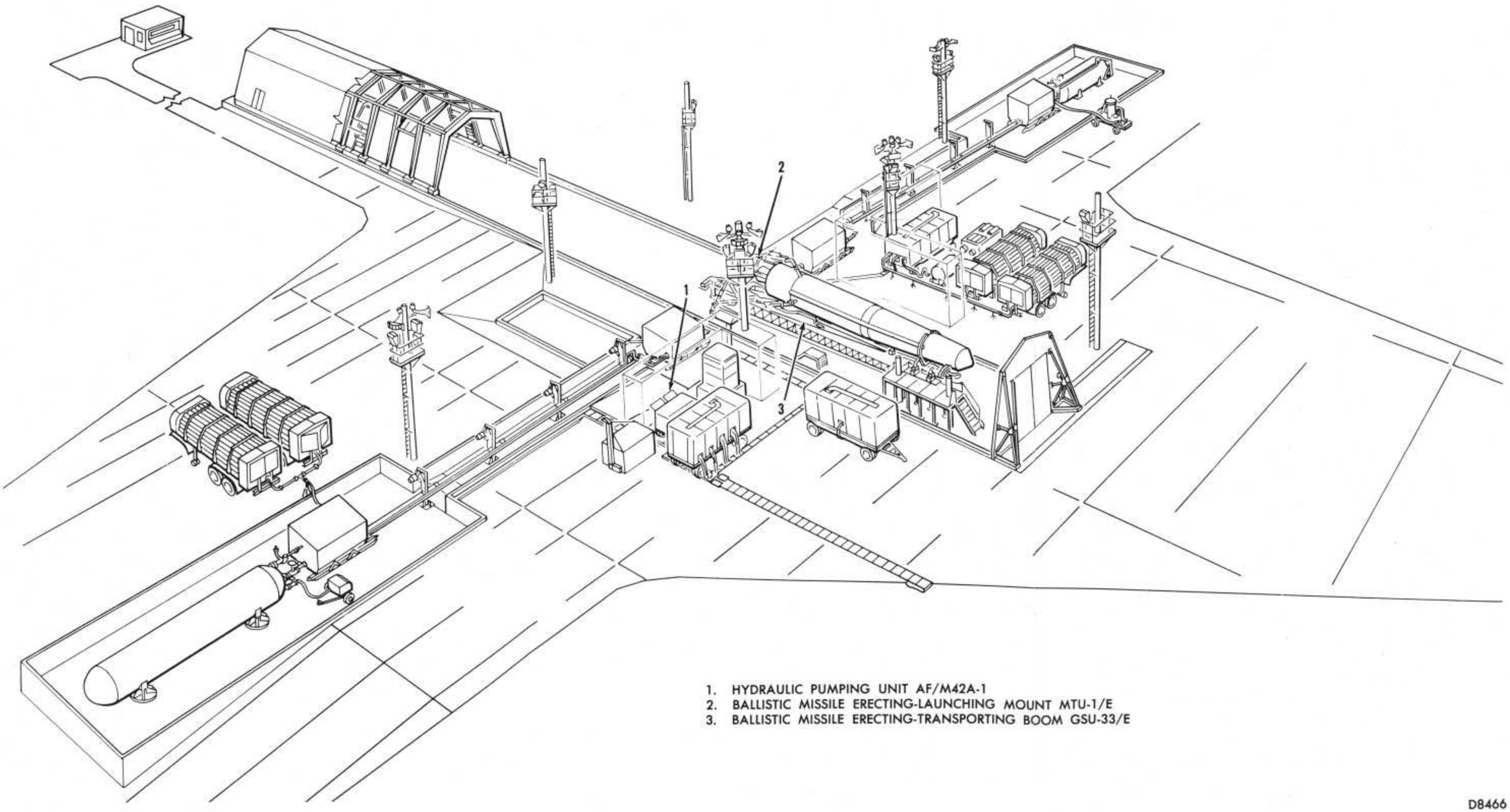


Figure 1-1. Ballistic Missile Launch Emplacement

Figure 1.1. Ballistic Missile Launch Emplacement

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Figure 1-3. Ballistic Missile Erecting-Transporting Boom GSU-33/E

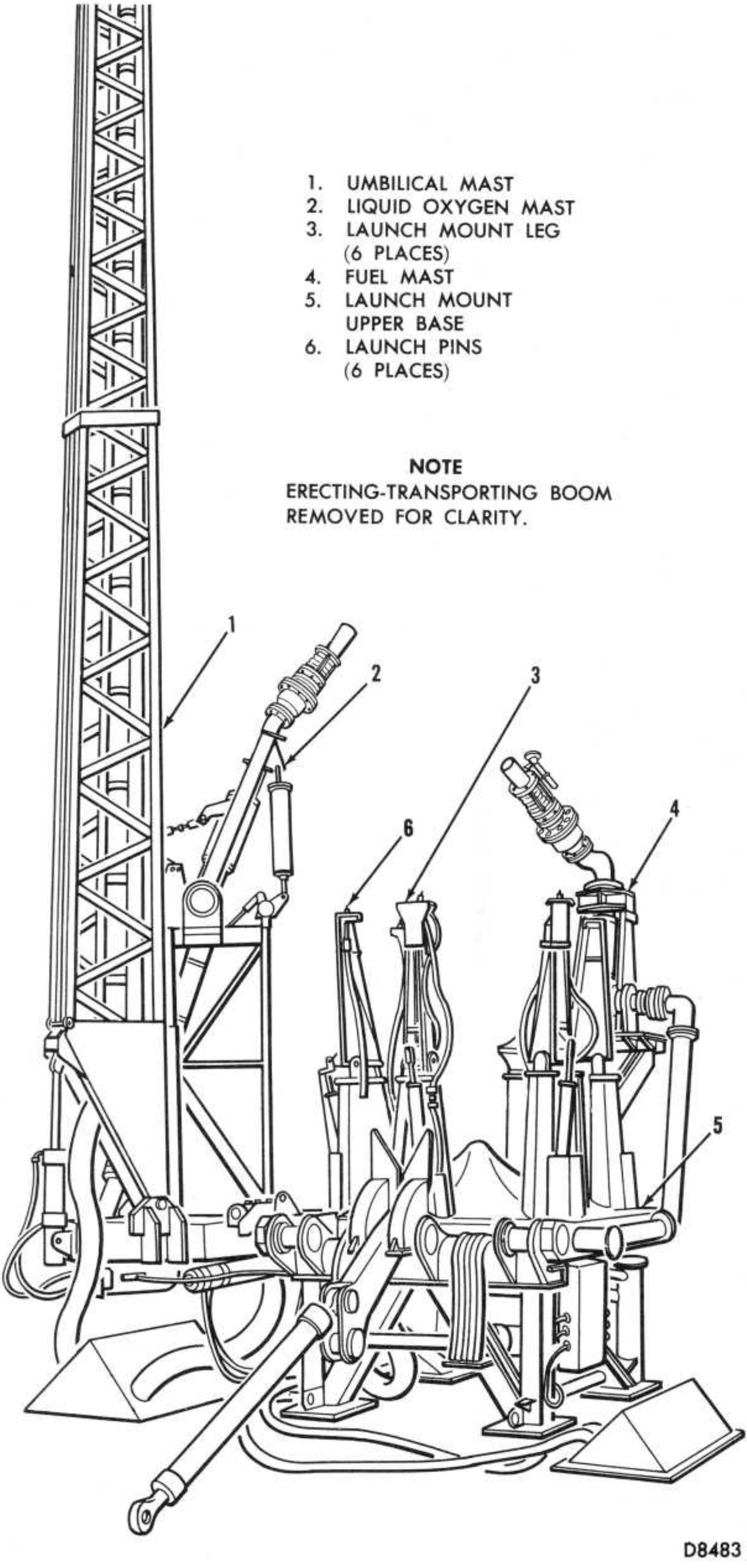
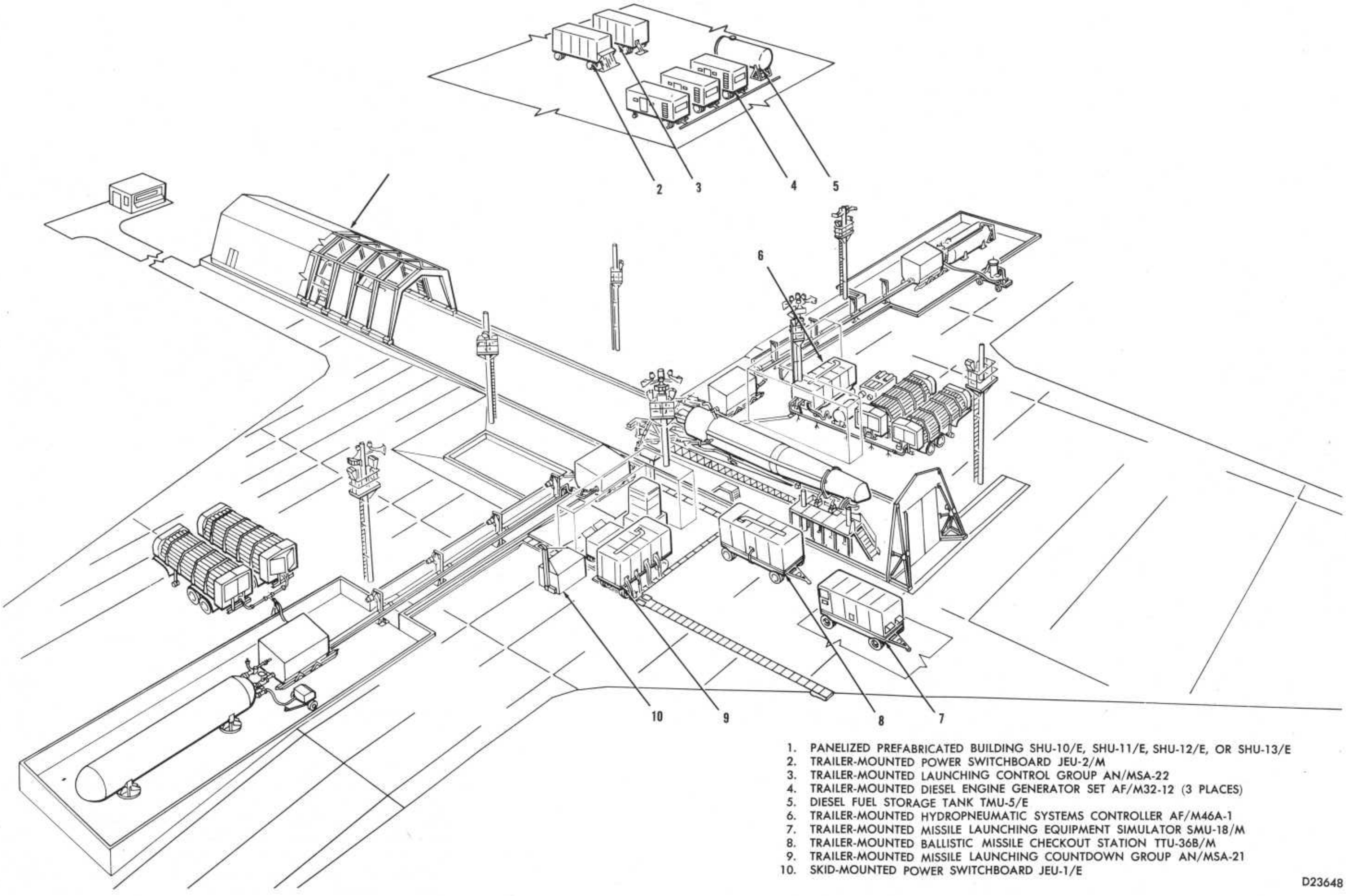


Figure 1-4. Ballistic Missile Erecting-Launching Mount MTU-1/E

T.O. 21-SM75-1J-2-9 Section I



1. PANELIZED PREFABRICATED BUILDING SHU-10/E, SHU-11/E, SHU-12/E, OR SHU-13/E
2. TRAILER-MOUNTED POWER SWITCHBOARD JEU-2/M
3. TRAILER-MOUNTED LAUNCHING CONTROL GROUP AN/MSA-22
4. TRAILER-MOUNTED DIESEL ENGINE GENERATOR SET AF/M32-12 (3 PLACES)
5. DIESEL FUEL STORAGE TANK TMU-5/E
6. TRAILER-MOUNTED HYDROPNEUMATIC SYSTEMS CONTROLLER AF/M46A-1
7. TRAILER-MOUNTED MISSILE LAUNCHING EQUIPMENT SIMULATOR SMU-18/M
8. TRAILER-MOUNTED BALLISTIC MISSILE CHECKOUT STATION TTU-36B/M
9. TRAILER-MOUNTED MISSILE LAUNCHING COUNTDOWN GROUP AN/MSA-21
10. SKID-MOUNTED POWER SWITCHBOARD JEU-1/E

Figure 1-1. Launch Position Power Generation and Distribution System

Figure 1-1. Launch Position Power Generation and Distribution System

1 October 1960 1-9

T.O. 21-SM75-1F-2-4 Section I

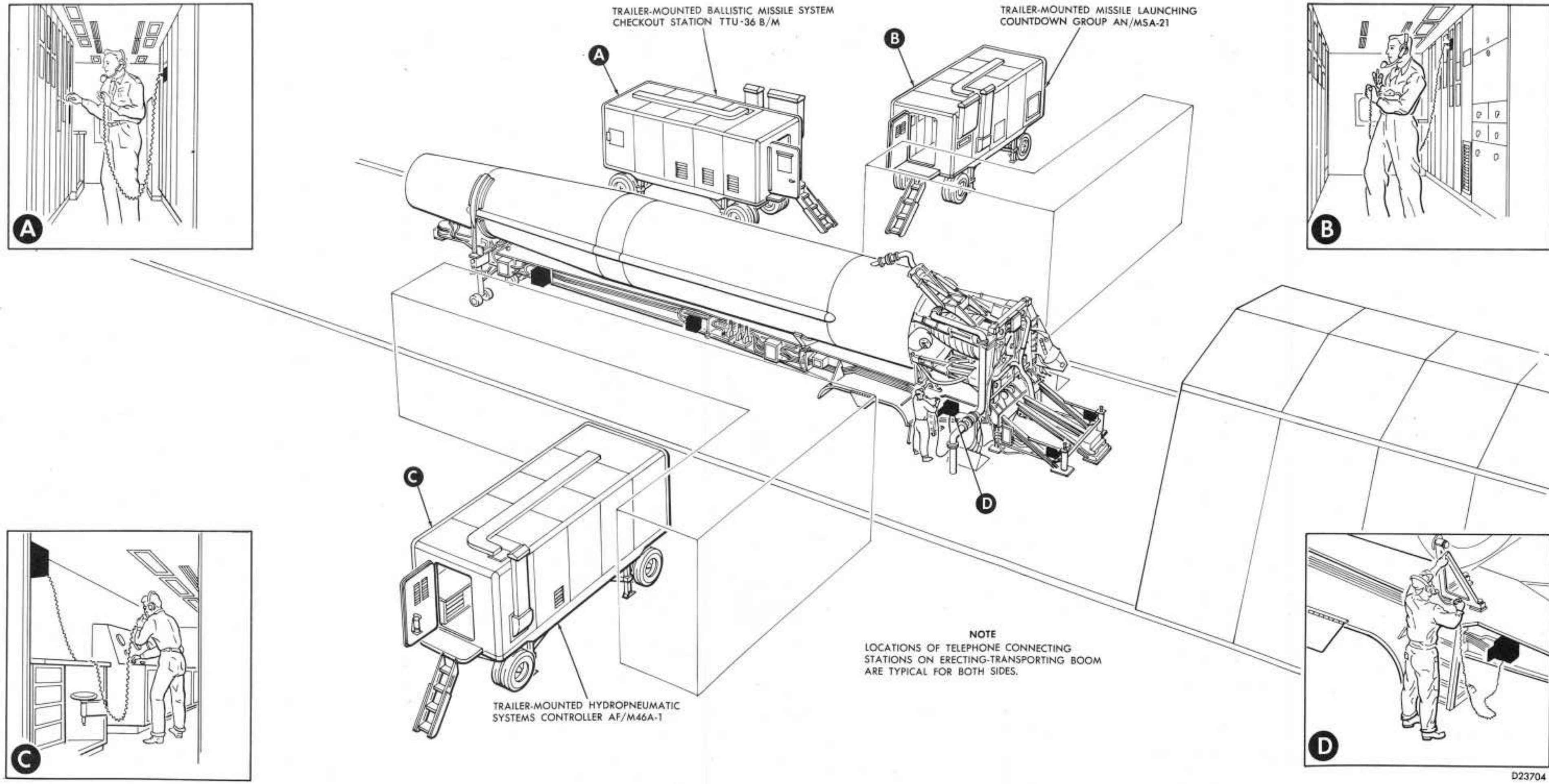


*Figure 1-1. **Communication Locations—Launch Emplacement Maintenance Network***

*Figure 1-1. **Communication Locations—Launch Emplacement Maintenance Network***

15 August 1960 1-3

Section I T.O. 21-SM75-1F-2-4

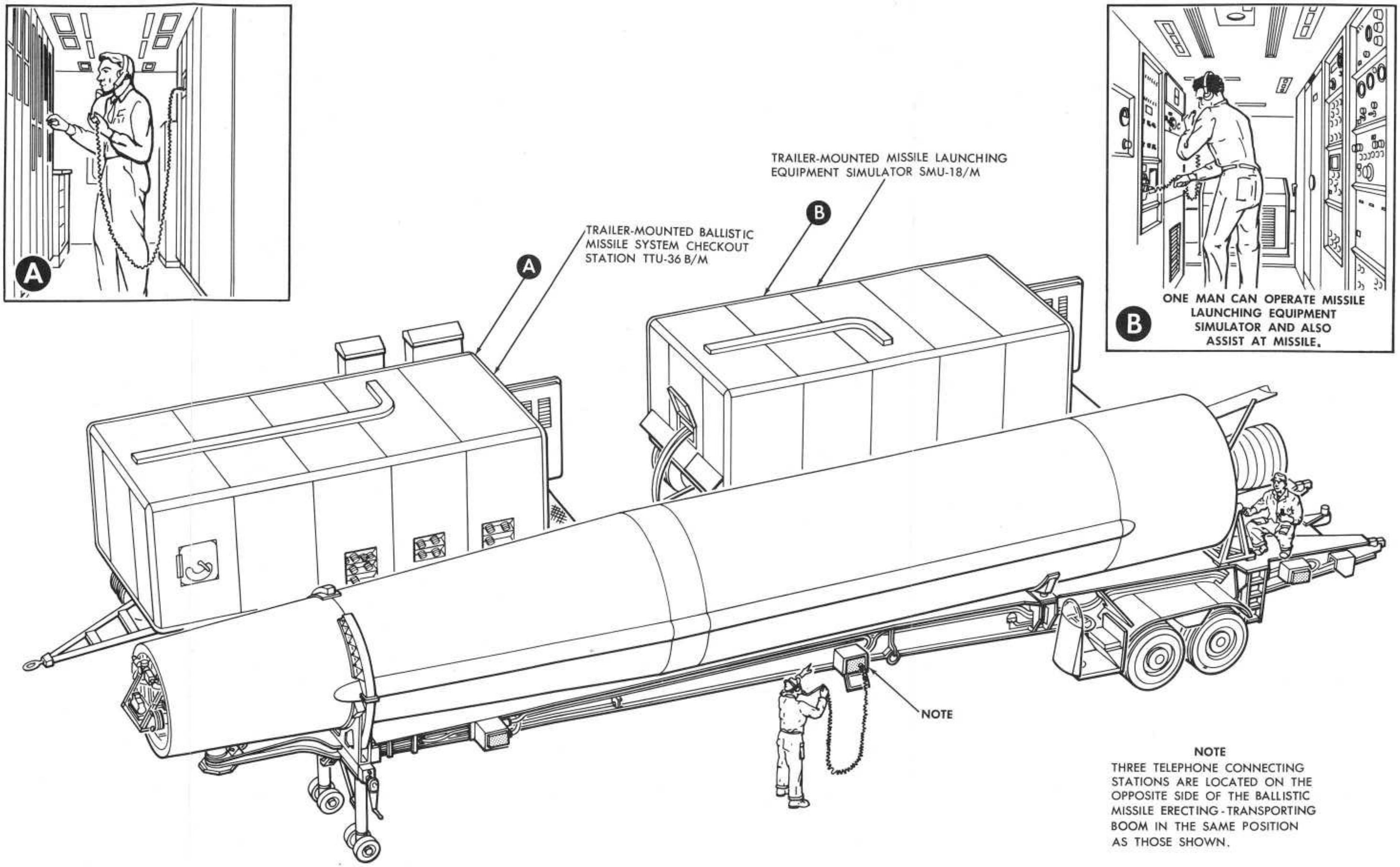


Figure 1-2. Communication Locations—RIM Building Maintenance Network

Figure 1-2. Communication Locations—RIM Building Maintenance Network

1-4 15 August 1960

Section II T.O. 21-SM75-1F-2-4

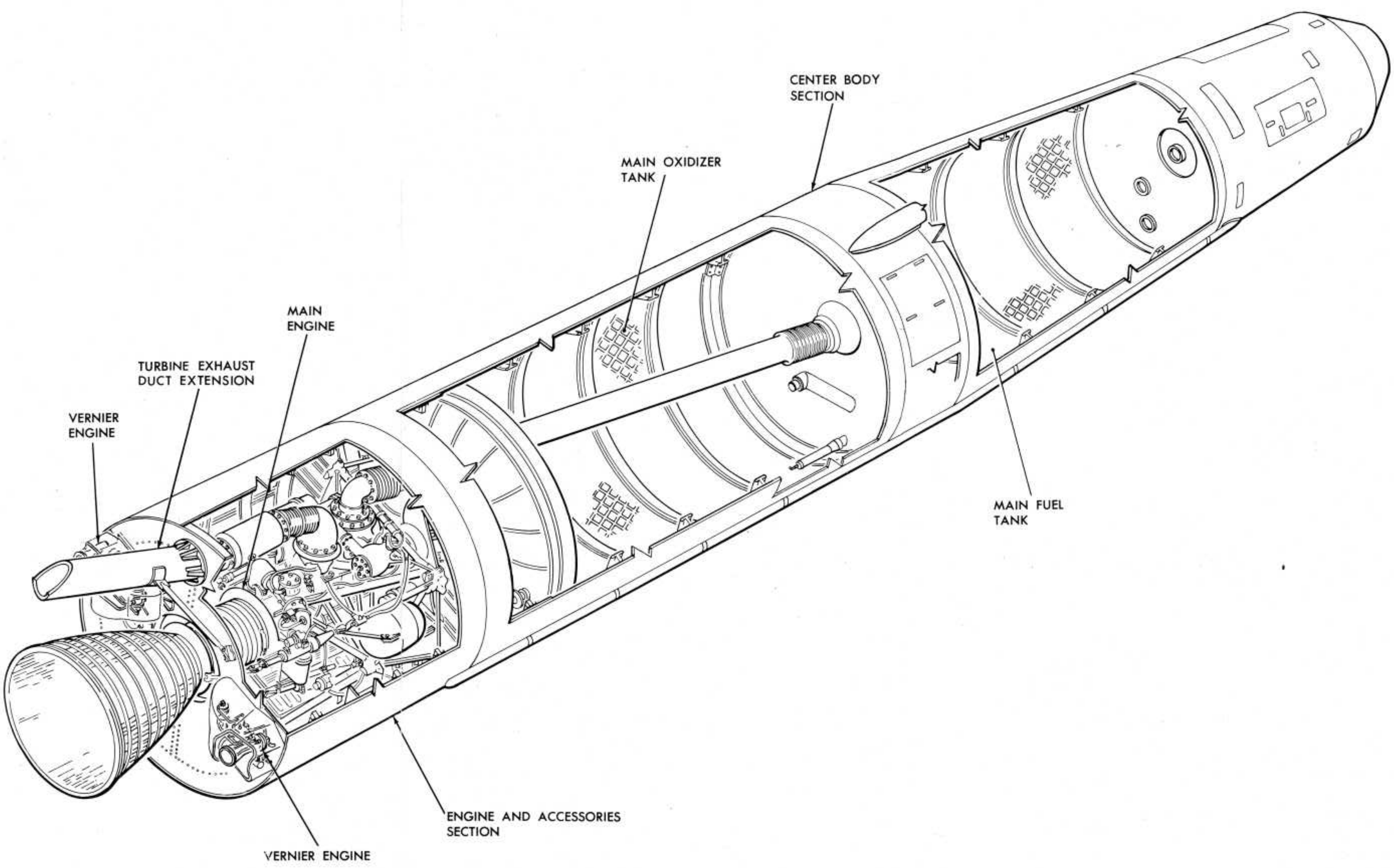
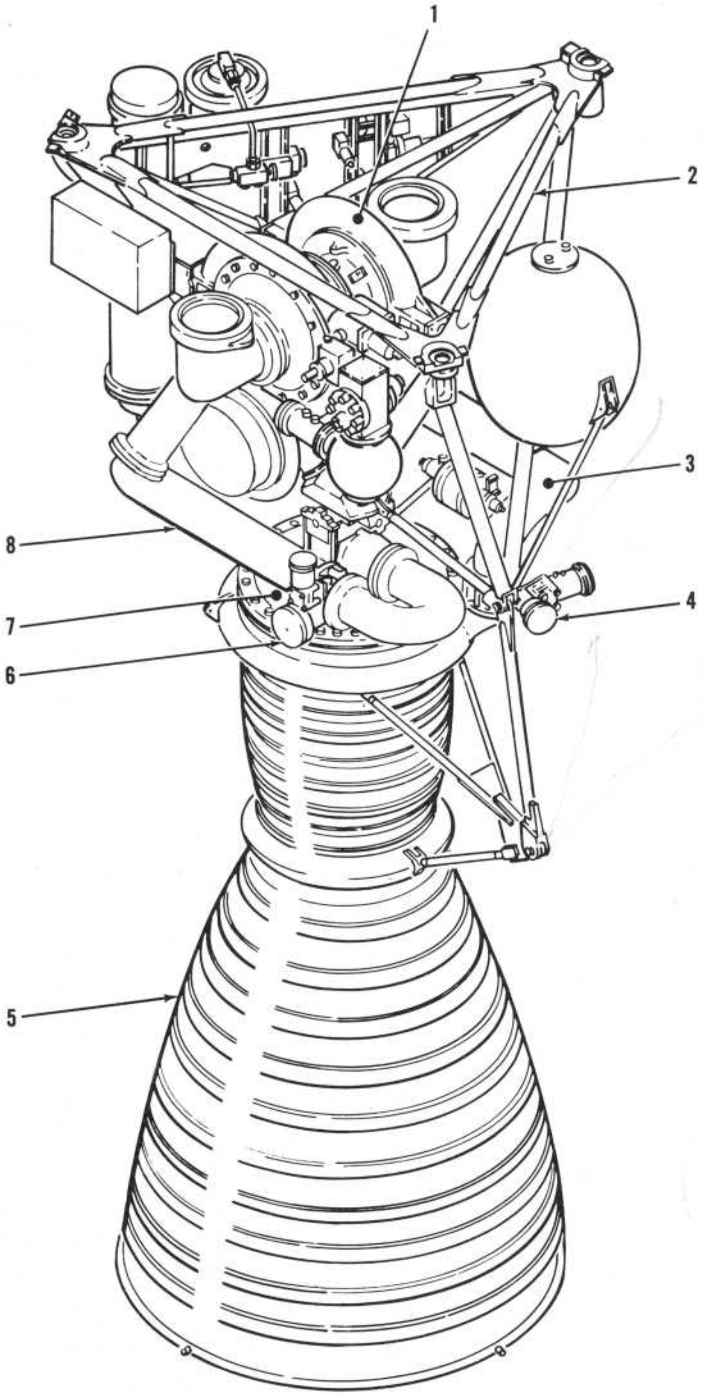


Figure 2-1. Rocket Engine Propulsion System

Figure 2-1. Rocket Engine Propulsion System

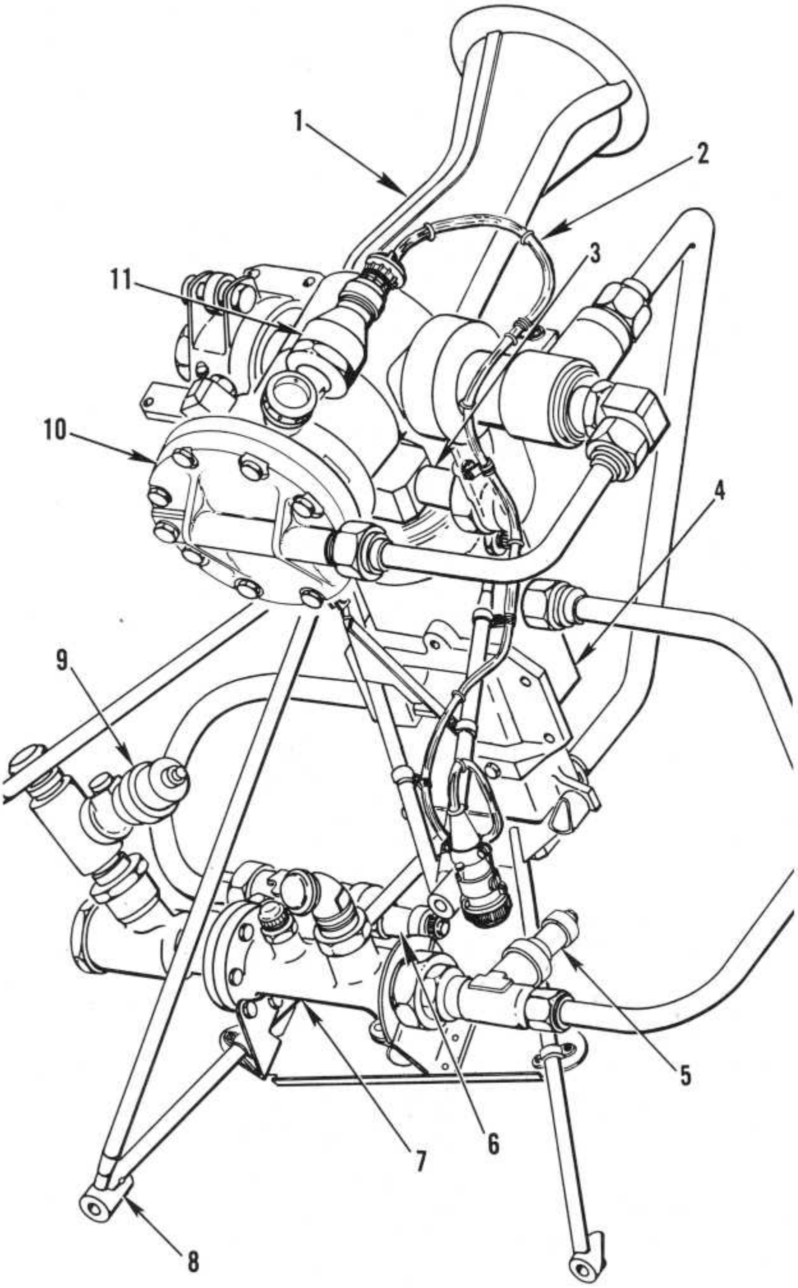
2-2 15 August 1960



1. TURBOPUMP
2. MAIN ENGINE THRUST FRAME
3. HIGH-PRESSURE FUEL DUCTING
4. MAIN FUEL VALVE
5. THRUST CHAMBER
6. MAIN OXIDIZER VALVE
7. MAIN ENGINE OXIDIZER DOME
8. HIGH-PRESSURE OXIDIZER DUCTING

D25932

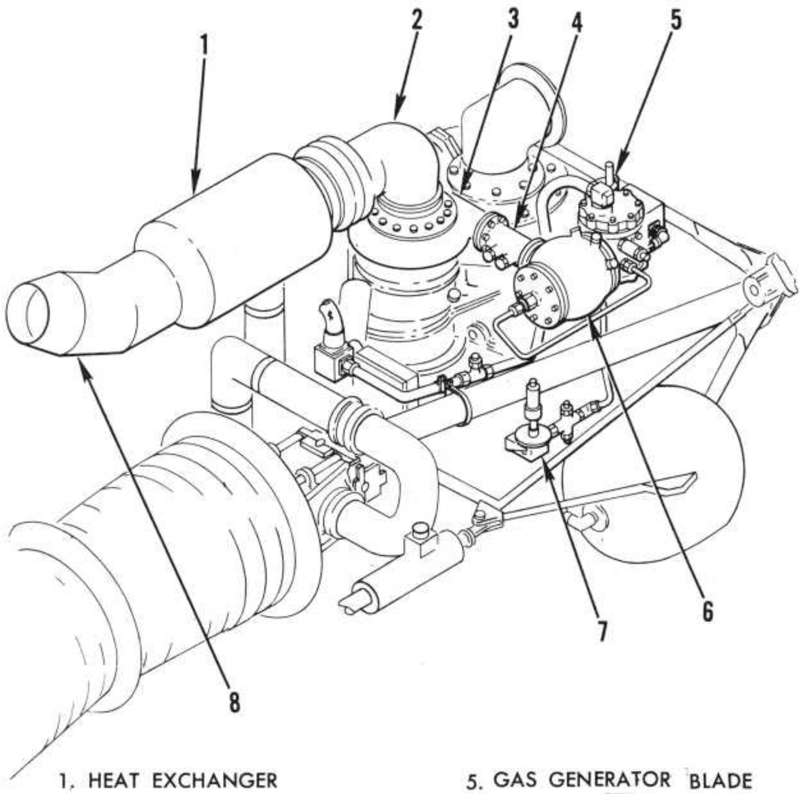
Figure 2-2. Main Engine



1. VERNIER THRUST CHAMBER BODY
2. ELECTRICAL CABLE HARNESS
3. GIMBAL SHAFT
4. GIMBAL HOUSING
5. FUEL PURGE CHECK VALVE
6. OXIDIZER PURGE CHECK VALVE
7. VERNIER PROPELLANT VALVE
8. VERNIER ENGINE MOUNT
9. VERNIER OXIDIZER BLEED VALVE
10. VERNIER OXIDIZER DOME
11. VERNIER PRESSURE SWITCH

D22209B

Figure 2-4. Vernier Engine (XLR101-NA-5)



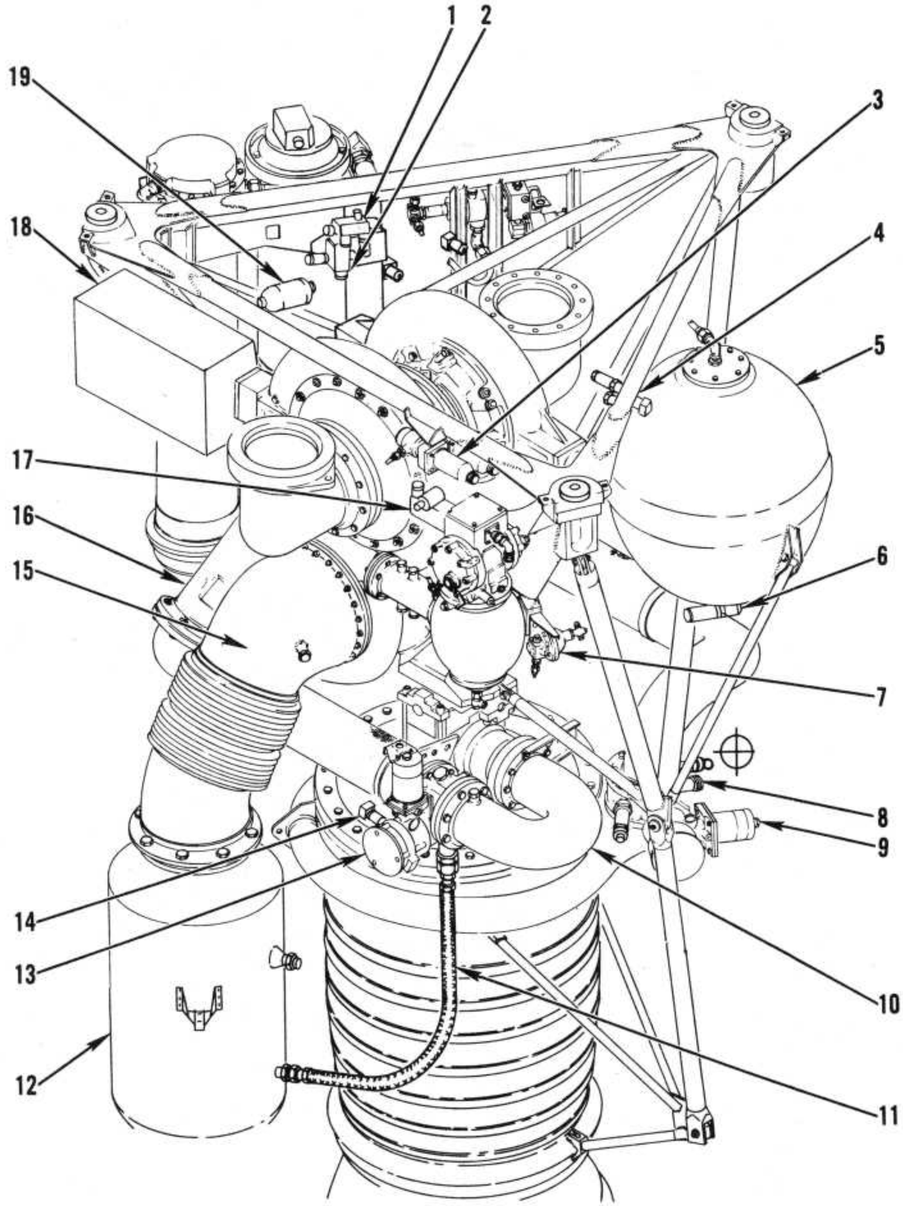
1. HEAT EXCHANGER
2. TURBINE EXHAUST HOOD
3. TURBINE
4. TURBINE INLET DUCT
5. GAS GENERATOR BLADE VALVE ACTUATOR
6. GAS GENERATOR ASSEMBLY
7. OXIDIZER REGULATOR
8. TURBINE EXHAUST DUCT

D22214C

Figure 2-6. Gas Generator, Turbine, and Exhaust Subsystem

Figure and Index No.	*Component*	*Purpose*
5, 2-7 and 2-8	Gas dump valve	Provides overboard venting of the missile bottles
2, 2-7 and 2-9	Main fuel tank pressurizing control valve	Controls flow of pressurized nitrogen from the missile bottles to the main fuel tank

T.O. 21-SM75-1J-2-5 Section II



1. FUEL START TANK PRESSURIZING VENT-AND-OVERFLOW VALVE
2. OXIDIZER START TANK PRESSURIZING VALVE
3. FOUR-WAY PNEUMATIC CONTROL VALVE
4. OIL TANK PRESSURIZING VALVE
5. OIL TANK
6. FILL-FLOW RESTRICTOR VALVE.
7. GAS GENERATOR OXIDIZER REGULATOR
8. FUEL PURGE CHECK VALVE
9. MAIN FUEL VALVE
10. OXIDIZER 180-DEGREE ELBOW
11. HEAT EXCHANGER HOSE ASSEMBLY
12. HEAT EXCHANGER
13. MAIN OXIDIZER VALVE
14. OXIDIZER DOME PURGE CHECK VALVE
15. TURBINE EXHAUST HOOD
16. FUEL PUMP OUTLET DUCT
17. GAS GENERATOR BLADE VALVE ACTUATOR
18. ENGINE RELAY BOX
19. ACCUMULATOR

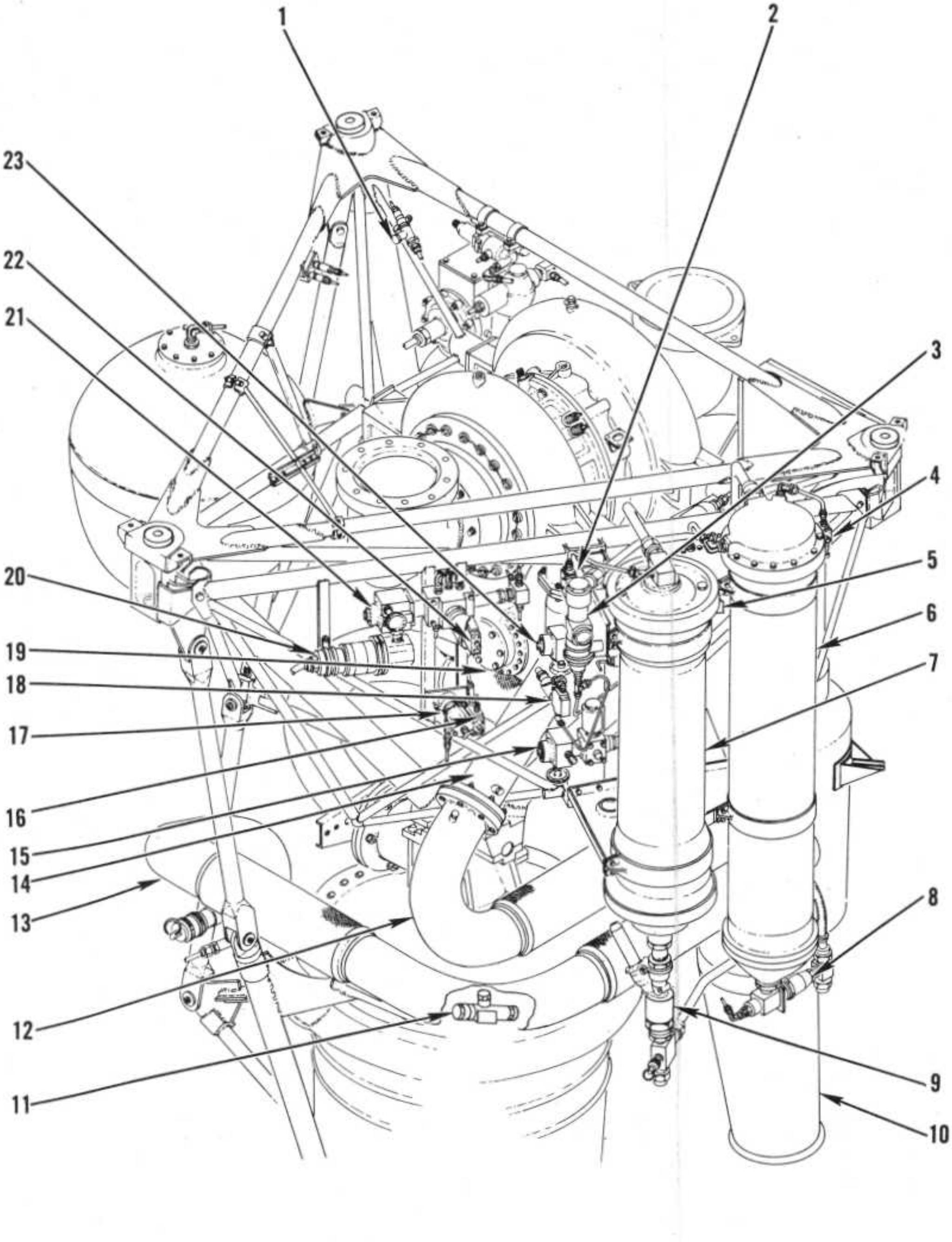
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Figure 2-1. XLR79-NA-7 Main Engine (Sheet 1 of 2)

Figure 2-1. XLR79-NA-7 Main Engine (Sheet 1 of 2)

1 March 1960 2-3

Section II T.O. 21-SM75-1J-2-5



1. GAS GENERATOR OXIDIZER PURGE CHECK VALVE
2. FUEL START TANK PRESSURE SWITCH
3. OXIDIZER START TANK VENT VALVE
4. OXIDIZER START TANK PRESSURE SWITCH
5. OXIDIZER RELIEF VALVE
6. OXIDIZER START TANK
7. FUEL START TANK
8. OXIDIZER FILL-AND-CHECK VALVE
9. FUEL FILL-AND-CHECK VALVE
10. TURBINE EXHAUST DUCT
11. IGNITION FUEL VALVE
12. FLEXIBLE OXIDIZER HOSE
13. FLEXIBLE FUEL HOSE
14. OXIDIZER PUMP OUTLET DUCT
15. FUEL START SUBSYSTEM PNEUMATIC CONTROL ASSEMBLY
16. VERNIER PROPELLANT VALVE CONTROL
17. MODIFIED GROVE LOADER
18. START TANKS PRESSURIZING CONTROL VALVE
19. ACCESSORY DRIVE ADAPTER
20. PNEUMATIC FILTER
21. PNEUMATIC CONTROL ASSEMBLY
22. VERNIER OXIDIZER BLEED VALVE CONTROL
23. OXIDIZER START SUBSYSTEM PNEUMATIC CONTROL ASSEMBLY

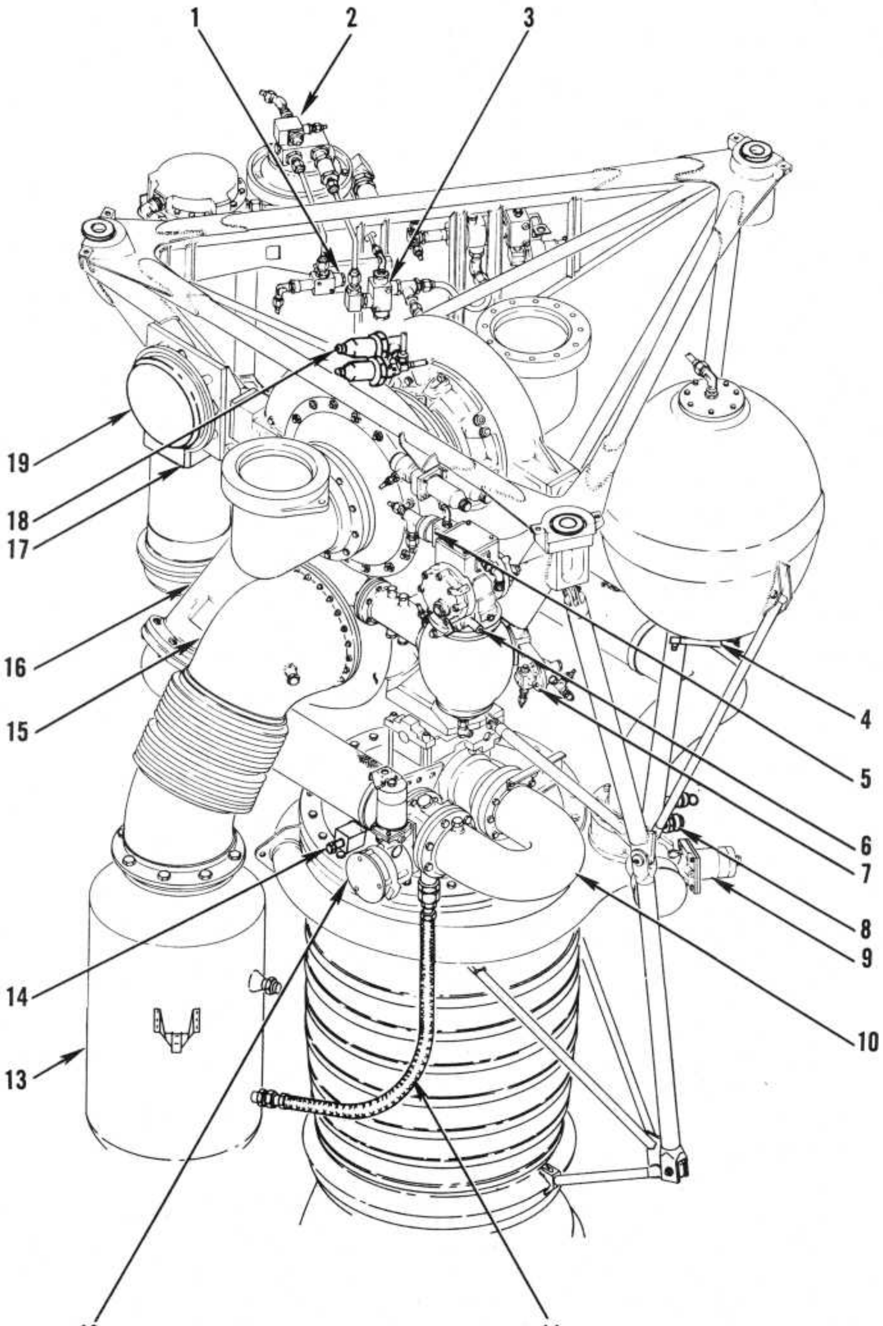
D-4848A

Figure 2-1. XLR79-NA-7 Main Engine (Sheet 2 of 2)

Figure 2-1. XLR79-NA-7 Main Engine (Sheet 2 of 2)

1 March 1960 2-4

T.O. 21-SM75-1J-2-5 Section II



1. FUEL START TANK VENT-AND-BLEED VALVE
2. FUEL START TANK PRESSURE SWITCH
3. FUEL START TANK PRESSURIZING VALVE
4. FILL-FLOW RESTRICTOR VALVE
5. GAS GENERATOR BLADE VALVE ACTUATOR
6. GAS GENERATOR FUEL PURGE CHECK VALVE
7. GAS GENERATOR OXIDIZER REGULATOR
8. FUEL PURGE CHECK VALVE
9. MAIN FUEL VALVE
10. OXIDIZER 180 DEGREE ELBOW
11. HEAT EXCHANGER HOSE ASSEMBLY
12. MAIN OXIDIZER VALVE
13. HEAT EXCHANGER
14. MAIN ENGINE OXIDIZER DOME PURGE CHECK VALVE
15. TURBINE EXHAUST HOOD
16. FUEL PUMP OUTLET DUCT
17. ENGINE JUNCTION BOX
18. START SUBSYSTEM FOUR-WAY PNEUMATIC CONTROL VALVE
19. ENGINE RELAY BOX

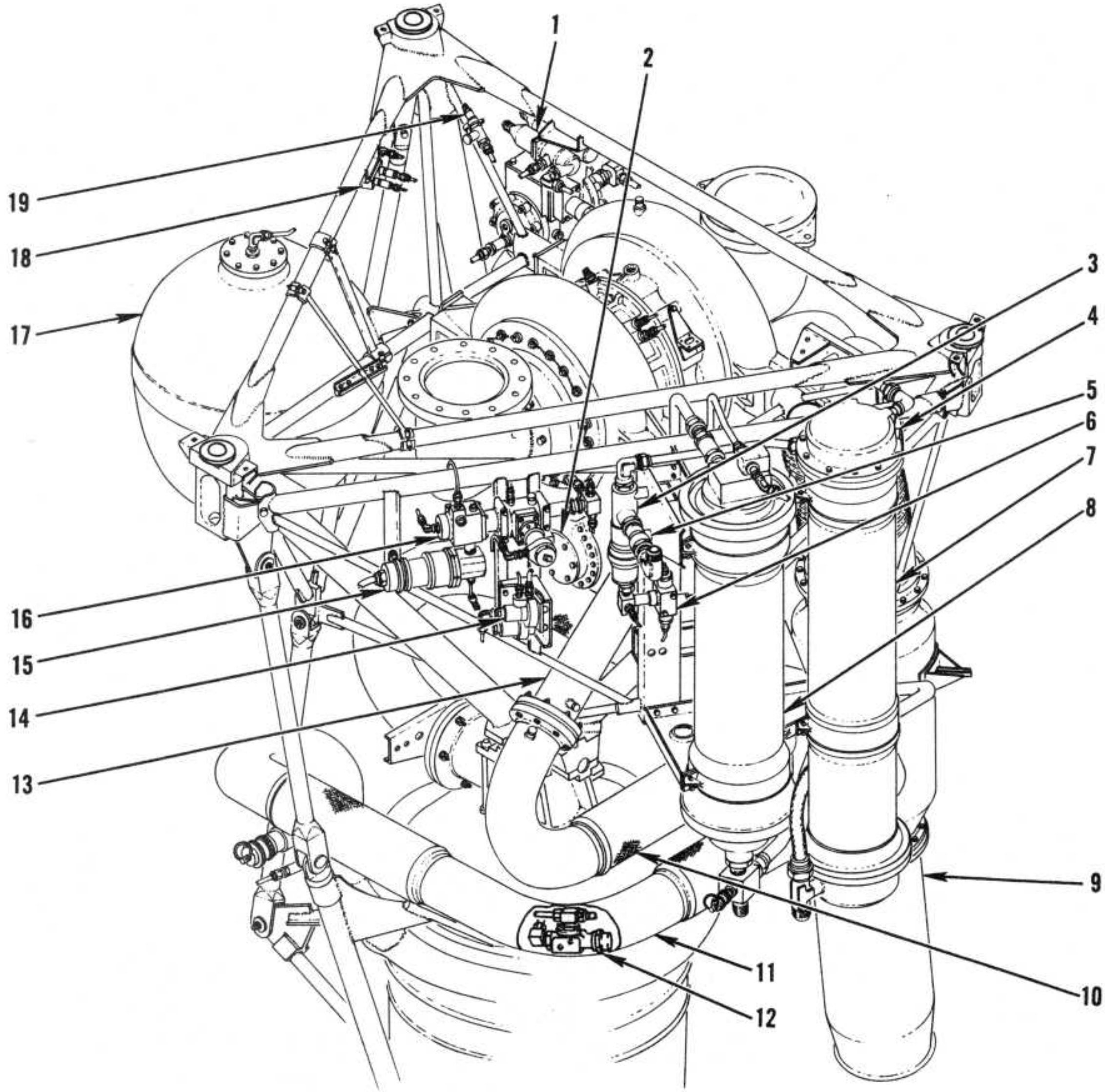
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Figure 2-2. XLR79-NA-9 Main Engine (Sheet 1 of 2)

Figure 2-2. XLR79-NA-9 Main Engine (Sheet 1 of 2)

1 March 1960 2-5

Section II T.O. 21-SM75-1J-2-5



1. FOUR-WAY PNEUMATIC CONTROL VALVE
2. ACCESSORY DRIVE ADAPTER
3. OXIDIZER START TANK VENT-AND-BLEED VALVE
4. OXIDIZER START TANK PRESSURE SWITCH
5. OXIDIZER START TANK RELIEF VALVE
6. OXIDIZER START TANK PRESSURIZING VALVE
7. OXIDIZER START TANK
8. FUEL START TANK
9. TURBINE EXHAUST DUCT
10. FLEXIBLE OXIDIZER HOSE
11. FLEXIBLE FUEL HOSE
12. IGNITION FUEL VALVE
13. OXIDIZER PUMP OUTLET DUCT
14. OXIDIZER REFERENCE-PRESSURE REGULATOR
15. PNEUMATIC FILTER
16. PNEUMATIC CONTROL ASSEMBLY
17. OIL TANK
18. OIL TANK PRESSURIZING VALVE
19. GAS GENERATOR OXIDIZER PURGE CHECK VALVE

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Figure 2-2. XLR79-NA-9 Main Engine (Sheet 2 of 2)

Figure 2-2. XLR79-NA-9 Main Engine (Sheet 2 of 2)

2-6 1 March 1960

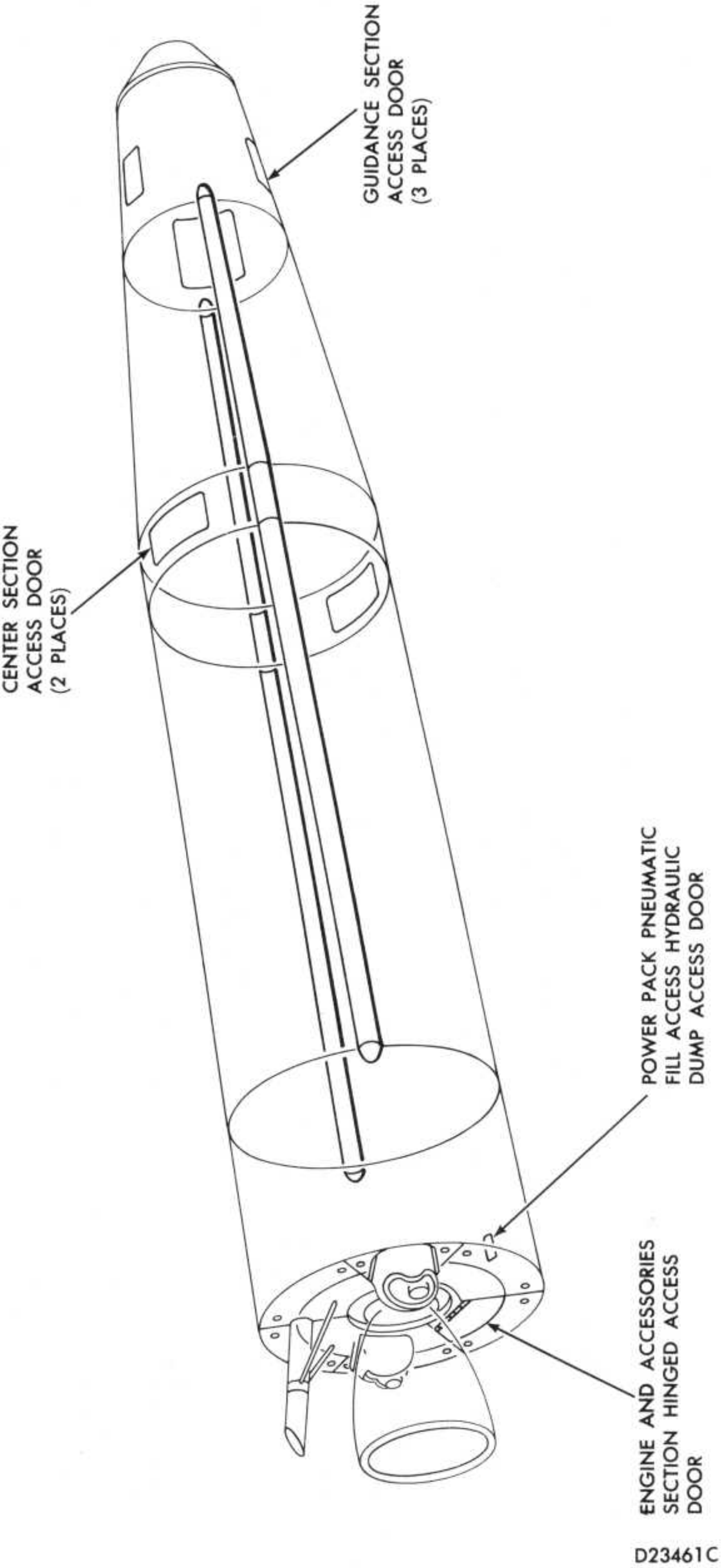


Figure 2-4. Location of Missile Access Doors

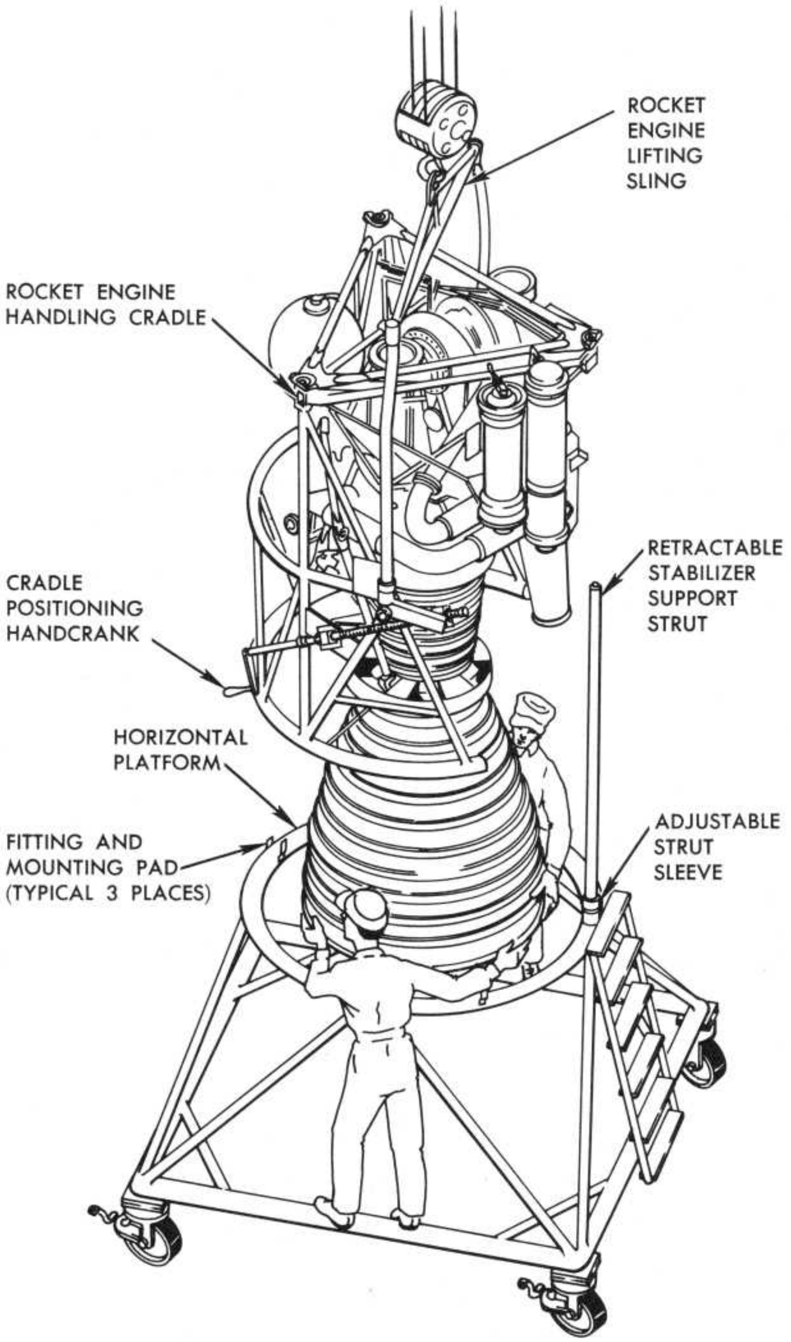


Figure 2-7. Installing Main Engine and Rocket Engine Handling Cradle on Transportation Trailer (Sheet 2 of 3)

T.O. 21-SM75-1J-2-6-1 Section I

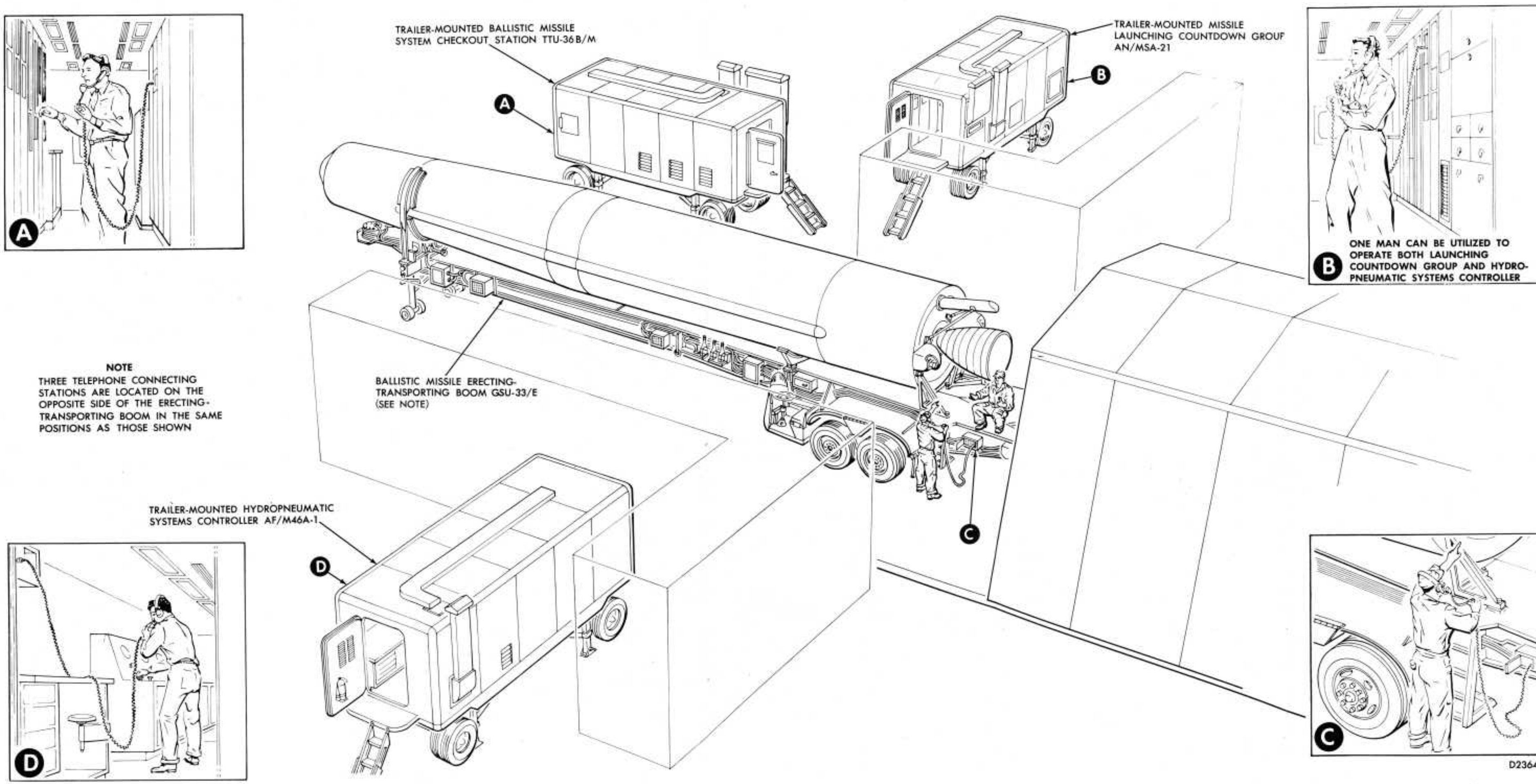


Figure 1-1. Communication and Personnel Locations—Launch Emplacement

Figure 1-1. Communication and Personnel Locations—Launch Emplacement

1 October 1960 1-3

Section I T.O. 21-SM75-1J-2-6-1

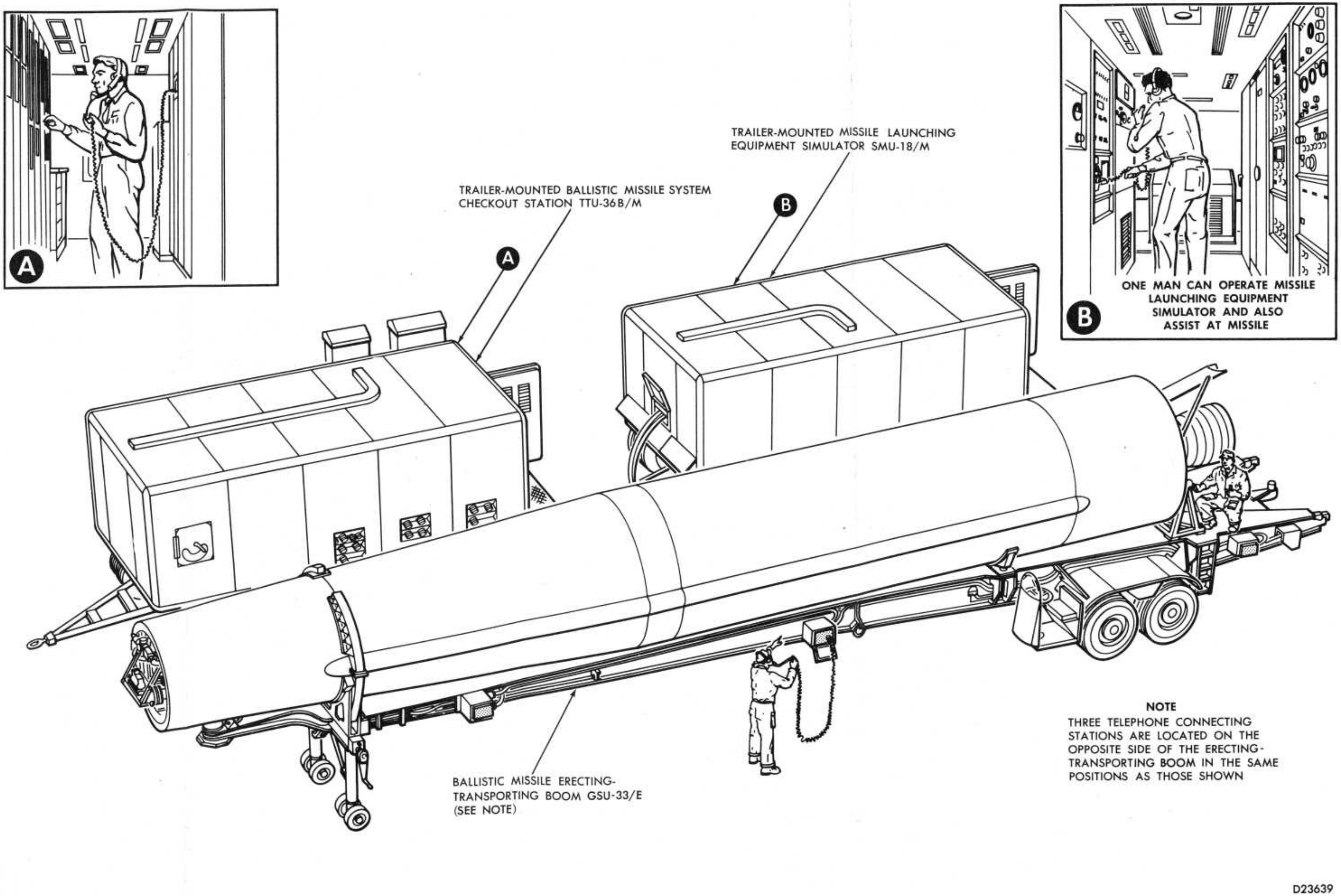


Figure 1-2. Communication and Personnel Locations—R/M Building

Figure 1-2. Communication and Personnel Locations—R/M Building

1-4 1 October 1960

Section II T.O. 21-SM75-1J-2-6-2

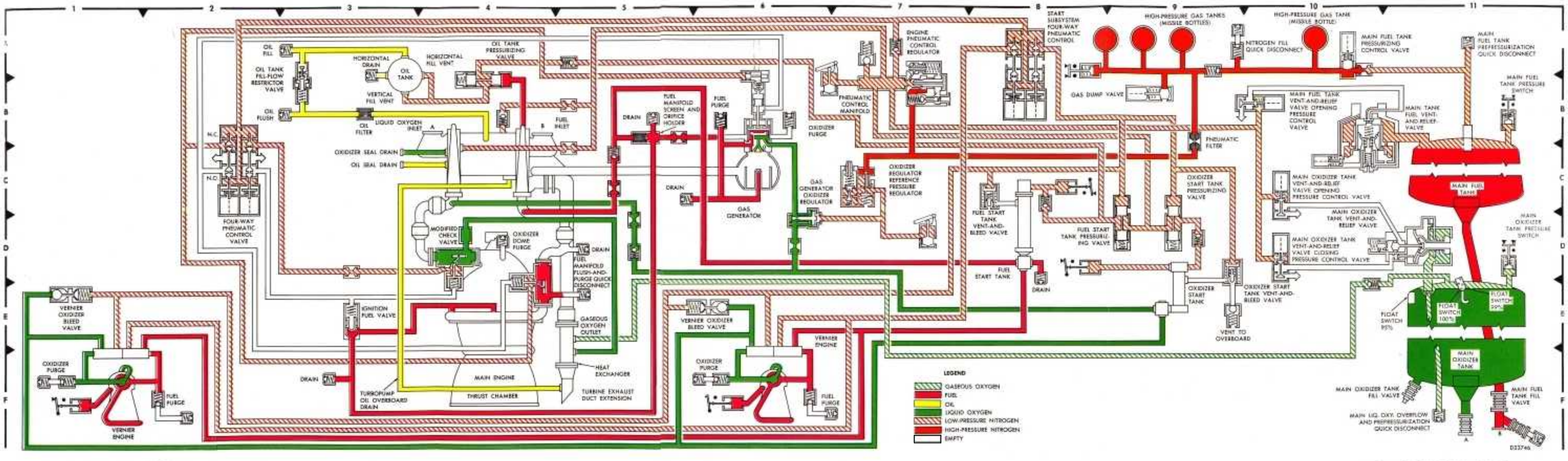
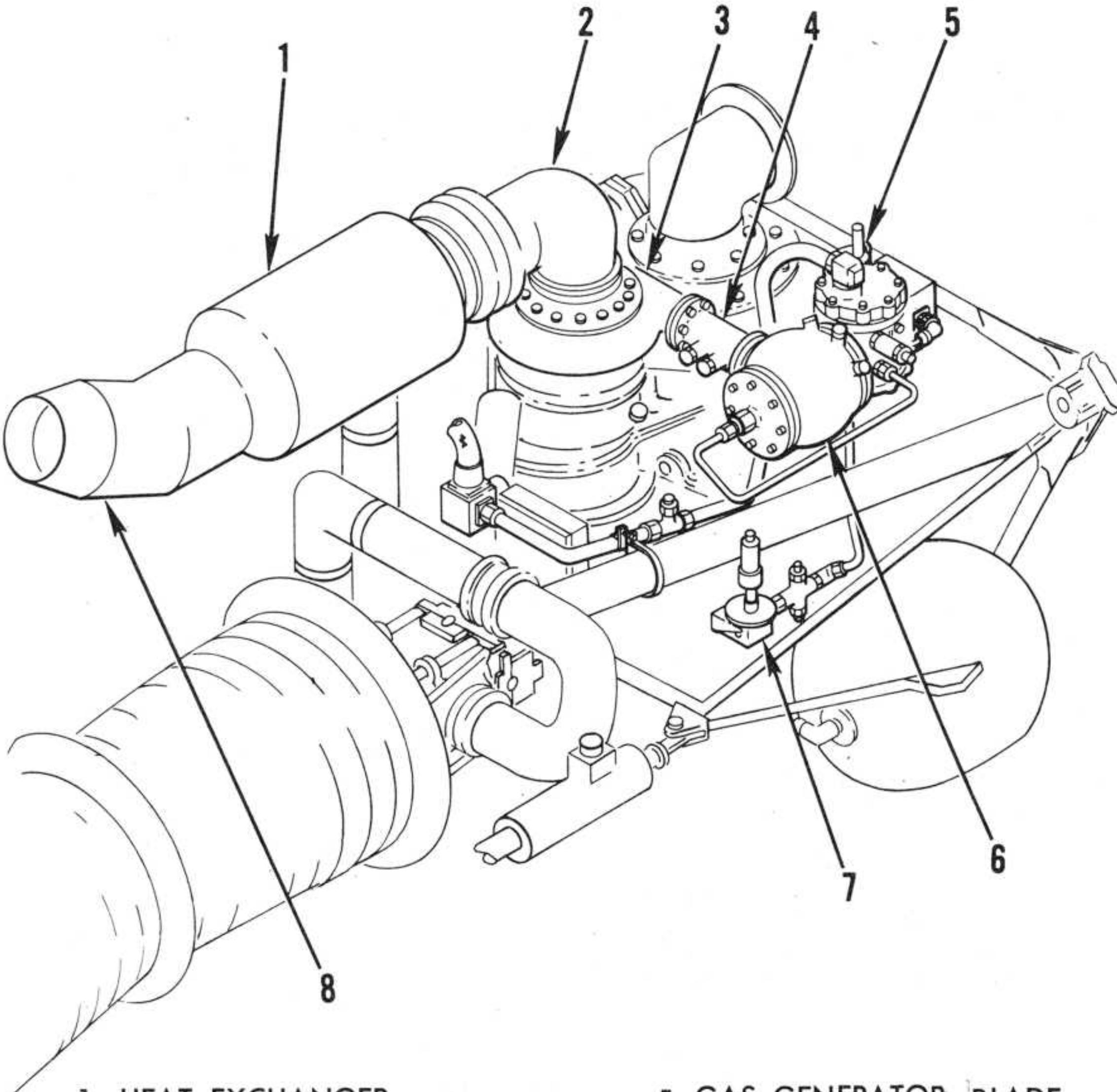


Figure 2-6. Rocket Engine Propulsion System — Schematic Diagram

Figure 2-6. Rocket Engine Propulsion System — Schematic Diagram

2-28 Changed 1 August 1961



1. HEAT EXCHANGER
2. TURBINE EXHAUST HOOD
3. TURBINE
4. TURBINE INLET DUCT
5. GAS GENERATOR BLADE VALVE ACTUATOR
6. GAS GENERATOR ASSEMBLY
7. OXIDIZER REGULATOR
8. TURBINE EXHAUST DUCT

D22214C

Figure 2-6. Gas Generator, Turbine, and Exhaust Subsystem

SECTION III

OPERATION

3-1. GENERAL SYSTEM OPERATION.

3-2. There are three launch emplacement environments in which the rocket engine propulsion system will be operated after reaching the ready condition. They are the dry exercise, the wet exercise, and the launching countdown.

3-3. Operation in the three environments requires propulsion system component response and indication in the proper sequence as related to other systems of the missile. Differences between the three environments, which affect the propulsion system, are as follows: during the wet exercise nitrogen pressure, and either liquid oxygen, or both liquid oxygen and fuel, is supplied to the propulsion system; during the dry exercise only nitrogen pressure is provided; during the wet or dry exercise, the propulsion system igniters are shorted out and the missile checkout station is utilized as required to simulate the sensors in the system.

3-4. The hydropneumatic systems controller, the launching countdown group, and the launching control group are used in all three environments to control and monitor the electrical power and pneumatic pressure. The necessary communications, electrical, and pressure connections between the launch emplacement, the GSE and the missile, as well as all other preparations, are made prior to the propulsion system operation.

3-5. The occurrence of malfunctions which stop the propulsion system operations, and which cannot be corrected within a certain time period, requires the system be returned to a maintenance status. All job operations necessary are performed at that time and also after the wet or dry exercise. These procedures are essential to make the propulsion system safe for additional operations and to return it to the ready condition.

3-6. During a launching countdown the propulsion system operation (figure 3-1) is essentially as follows: electrical

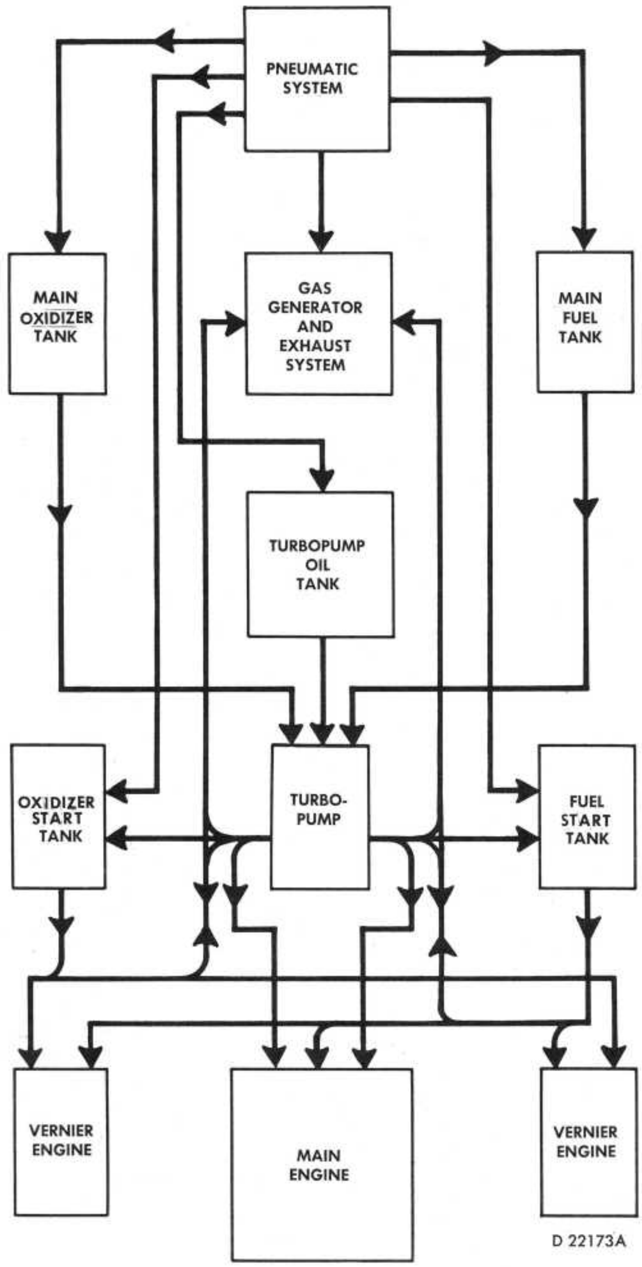
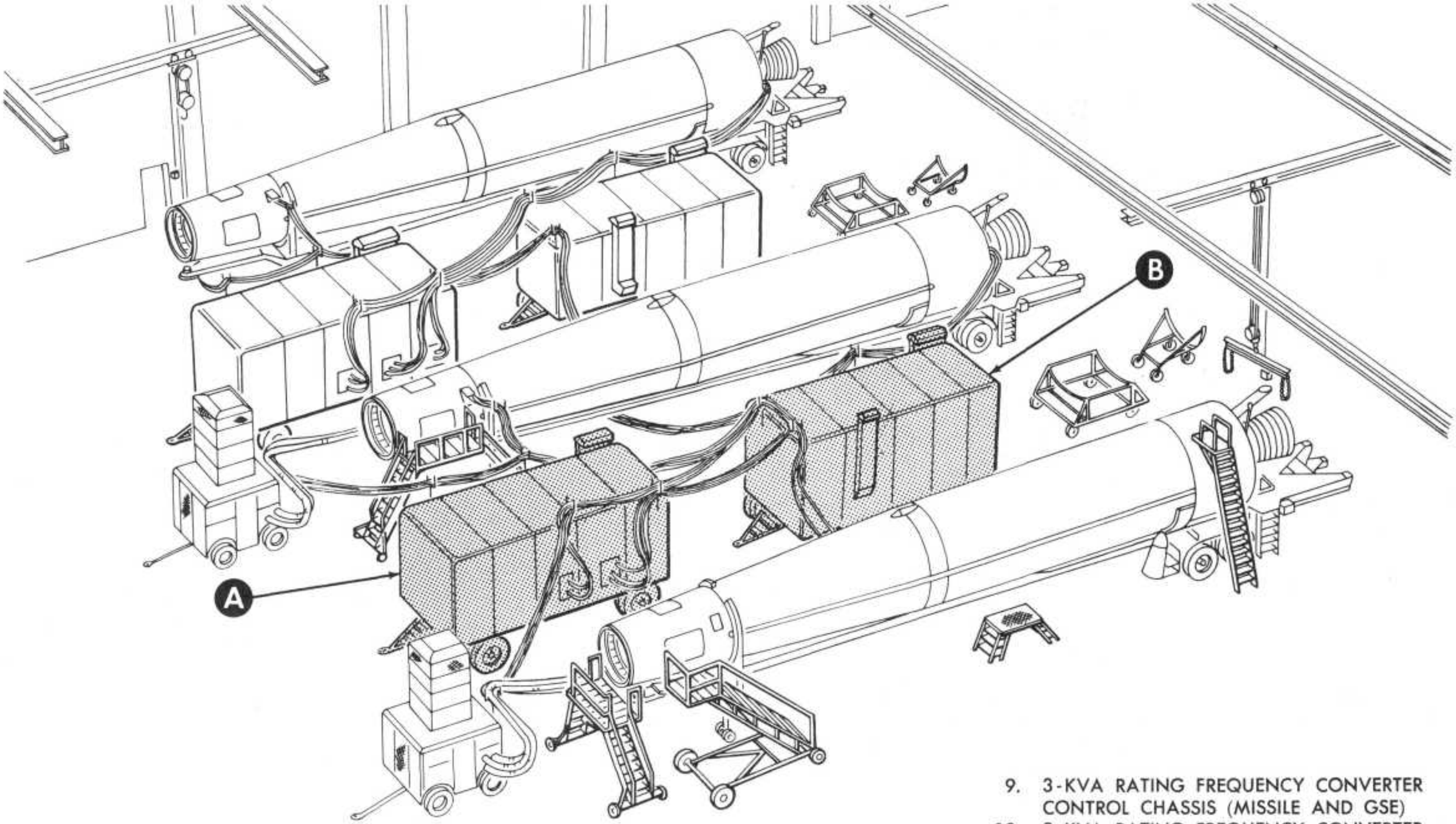


Figure 3-1. Rocket Engine Propulsion System—Block Diagram

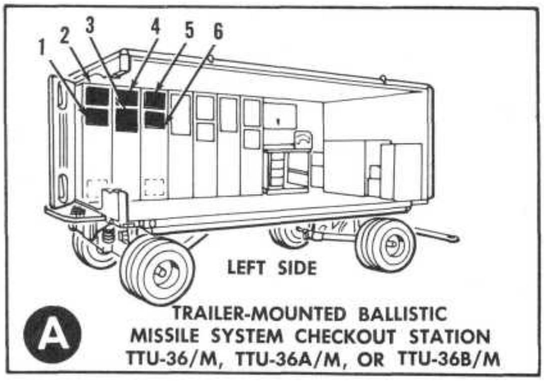
power is applied to all propulsion system heaters; the high-pressure pneumatic and control pressure pneumatic subsystems are pressurized; liquid oxygen flows to the main oxidizer tank, and fuel flows to the main fuel tank; the fuel start tank and the oxidizer start tank, which are gravity filled, are pressurized when full; the main fuel and the main oxidizer tanks are pressurized. The following occurs at this point in the propulsion system using the XLR79-NA-7 main engine: the two vernier engine igniters fire, and fuel and liquid oxygen from the start tanks flow to the vernier engines resulting in vernier engine combustion; the main engine igniter fires, and fuel from the start tank and liquid oxygen from the main oxidizer tank flow to the main engine resulting in main engine combustion. For the propulsion system using the XLR79-NA-9 main engine, the following occurs after the main fuel, main oxidizer, and start tanks are pressurized: the vernier and main engine igniters are fired; fuel and liquid oxygen from the start tanks flow to the vernier engines and fuel from the start tank and liquid oxygen from the main oxidizer tank flow to the main engine resulting in simultaneous main and vernier engine combustion. At this point operation of the propulsion system

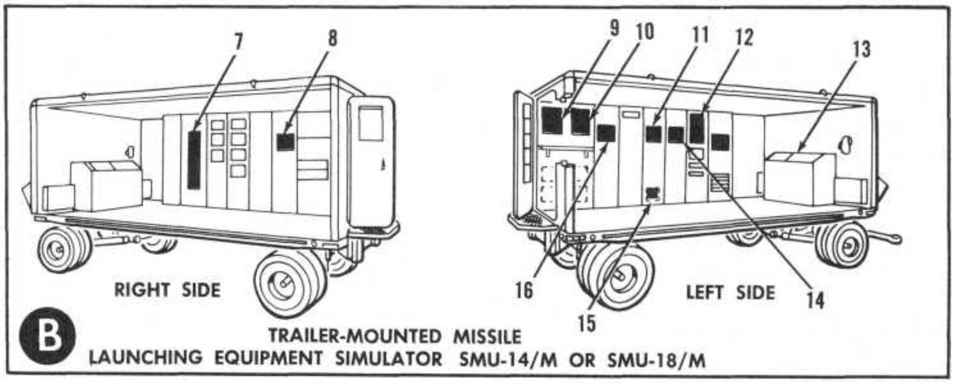
using either main engine configuration continues as follows: the gas generator igniter fires; igniter detector links break, and liquid oxygen and fuel from the start tanks flow to the gas generator. Combustion occurs producing the high-velocity gas which drives the turbopump; the turbopump oil tank is pressurized; liquid oxygen and fuel are then pumped from the main oxidizer and main fuel tanks to the main and vernier engines and the gas generator (this operation, which relieves the start subsystem, is called the bootstrap operation); and the main fuel valve opens at the same time and mainstage combustion results.

Section I T.O. 21-SM75-1J-2-3



1. POWER CHECKOUT PANEL
2. POWER CONTROL PANEL
3. BATTERY SIMULATOR POWER SUPPLY CONTROL CHASSIS
4. SIGNAL MONITOR PANEL
5. GIMBAL CONTROL PANEL
6. PROGRAMMER PANEL
7. POWER DISTRIBUTION PANEL
8. 150-AMPERE POWER SUPPLY CONTROL CHASSIS (MISSILE INVERTER)
9. 3-KVA RATING FREQUENCY CONVERTER CONTROL CHASSIS (MISSILE AND GSE)
10. 3-KVA RATING FREQUENCY CONVERTER CONTROL CHASSIS (MISSILE)
11. GUIDANCE POWER SUPPLY CONTROL CHASSIS
12. CIRCUIT BREAKER PANEL
13. HYDRAULIC GROUND POWER ASSEMBLY
14. 150-AMPERE POWER SUPPLY CONTROL CHASSIS (MISSILE AND GSE)
15. GUIDANCE POWER SUPPLY CHASSIS
16. CONTINUOUS POWER SUPPLY CONTROL CHASSIS





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Figure 1-1. RIM Building Ground Support Equipment

Figure 1-1. RIM Building Ground Support Equipment

1-2 1 November 1960

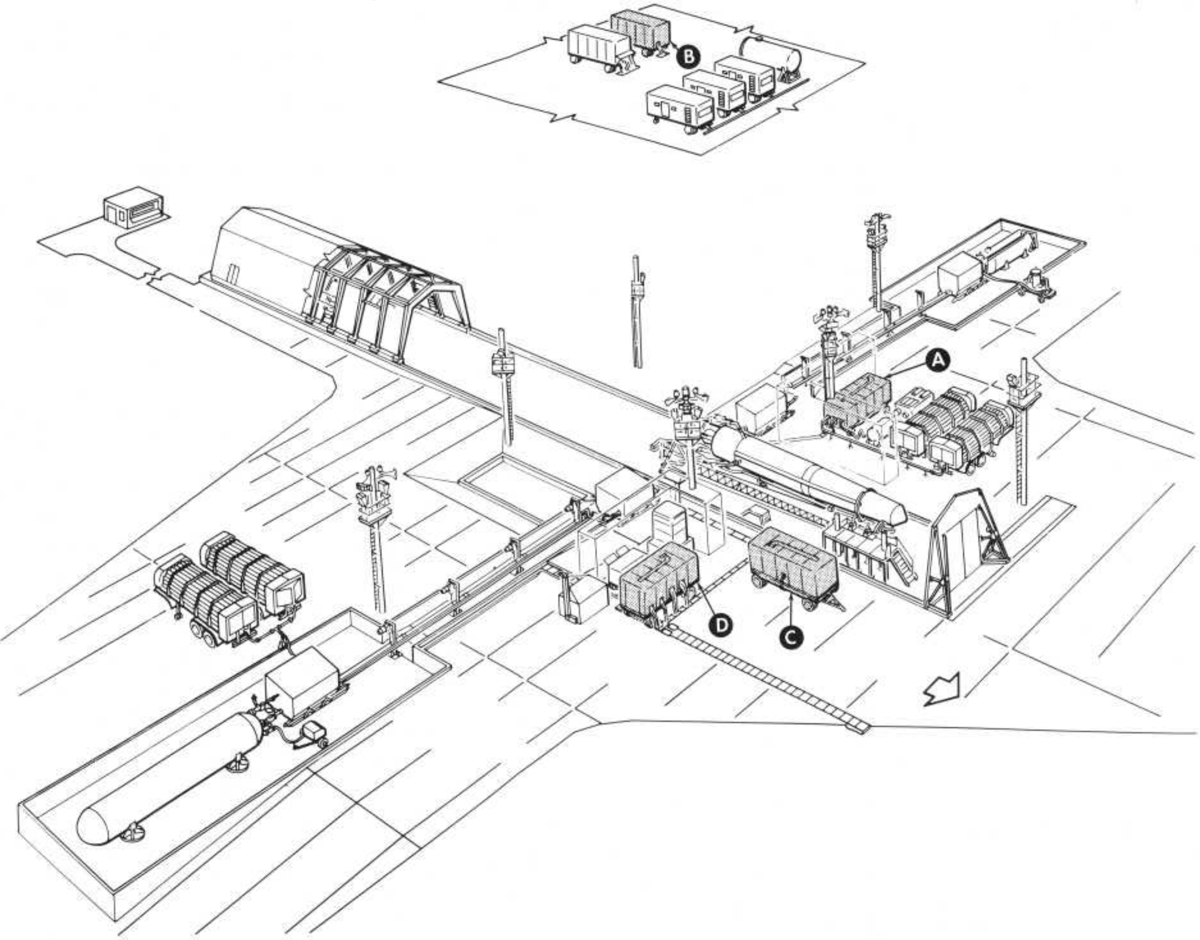
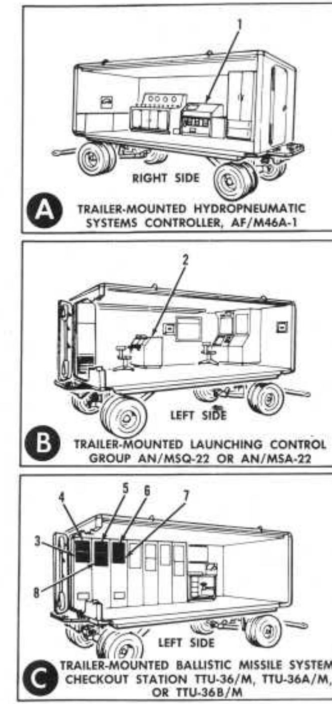


Figure 1-2. Launch Emplacement and Launch Control Area Ground Support Equipment

1. HYDRAULIC GROUND POWER UNIT
2. LAUNCH OFFICERS MISSILE CONTROL PANEL
3. POWER CHECKOUT PANEL
4. POWER CONTROL PANEL
5. SIGNAL MONITOR PANEL
6. GIMBAL CONTROL PANEL
7. PROGRAMMER PANEL
8. BATTERY SIMULATOR POWER SUPPLY CONTROL CHASSIS
9. 3-KVA RATING FREQUENCY CONVERTER CONTROL CHASSIS (MISSILE AND GSE)
10. 3-KVA RATING FREQUENCY CONVERTER CONTROL CHASSIS (MISSILE)
11. CONTINUOUS POWER SUPPLY
12. 150-AMPERE POWER SUPPLY (MISSILE AND GSE)
13. 150-AMPERE POWER SUPPLY (MISSILE INVERTER)
14. POWER DISTRIBUTION PANEL



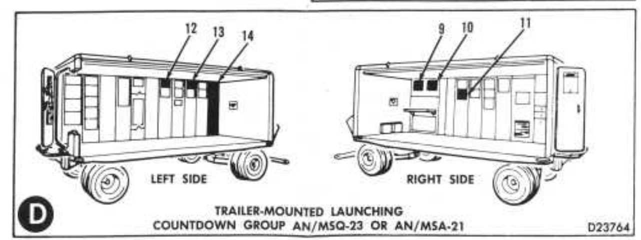


Figure 1-2. Launch Emplacement and Launch Control Area Ground Support Equipment

Section I T.O. 21-SM75-1J-2-3

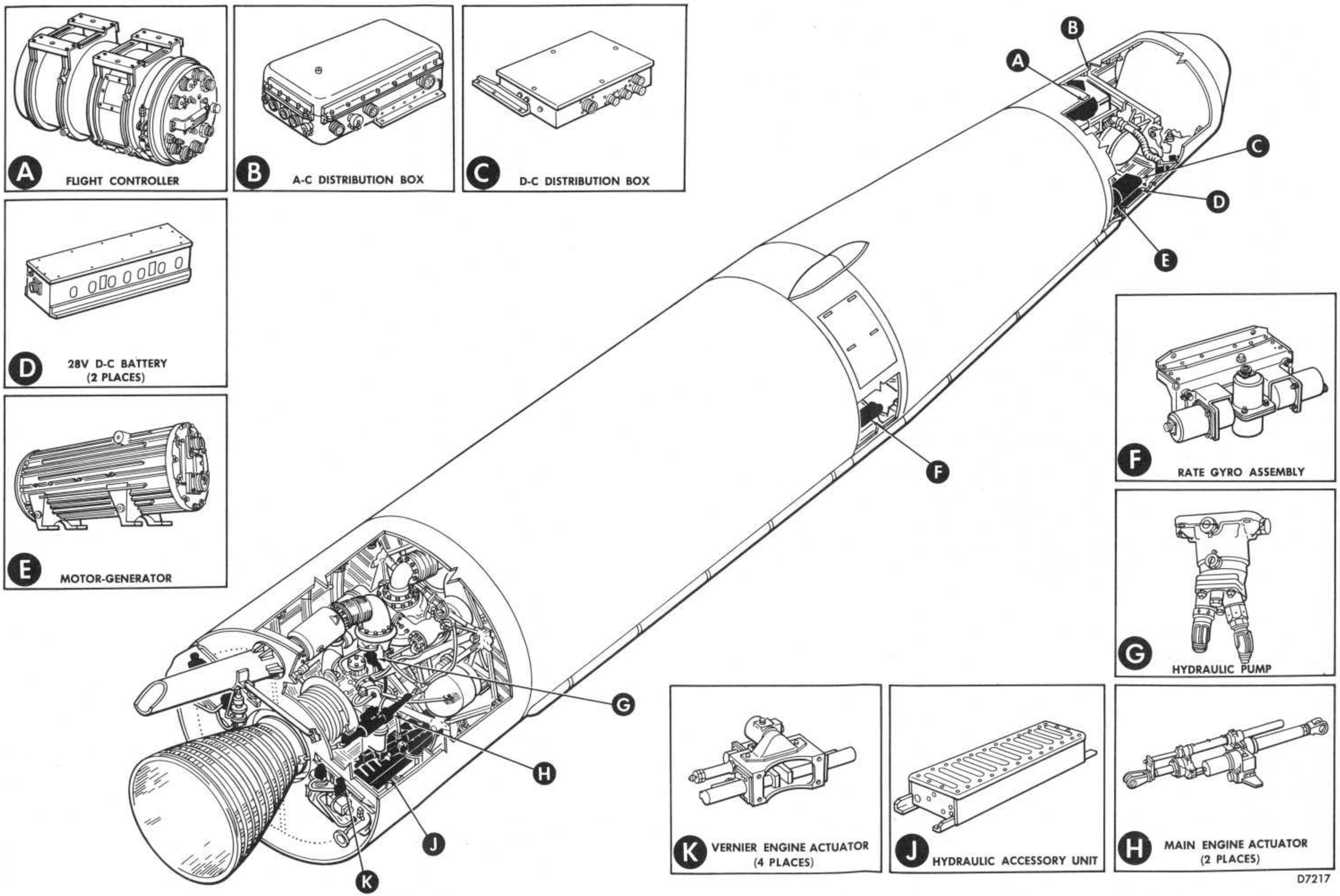
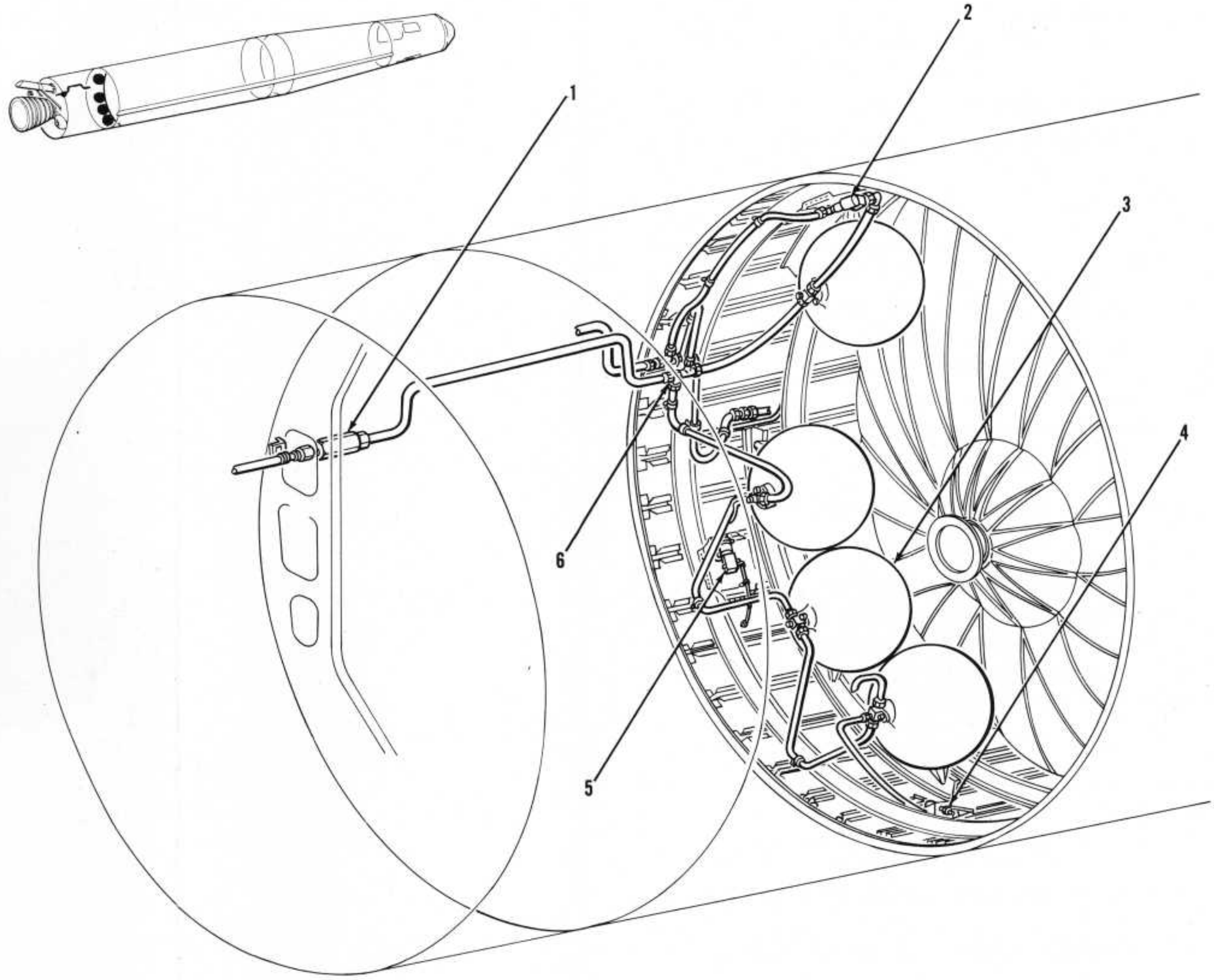


Figure 1-3. Flight Control System Airborne Components

Figure 1-3. Flight Control System Airborne Components

1-8 1 November 1960

Section II T.O. 21-SM75-1F-2-4



1. NITROGEN FILL-LINE CHECK VALVE
2. MAIN FUEL TANK PRESSURIZING CONTROL VALVE
3. HIGH-PRESSURE GAS TANKS (MISSILE BOTTLES) (4 PLACES)
4. HIGH-PRESSURE PNEUMATIC SUBSYSTEM PRESSURE SWITCH
5. GAS DUMP VALVE
6. MISSILE BOTTLES CHECK VALVE

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Figure 2-7. High-Pressure Pneumatic Subsystem

Figure 2-7. High-Pressure Pneumatic Subsystem

2-12 15 August 1960

Section I T.O. 21-SM75-1J-2-11

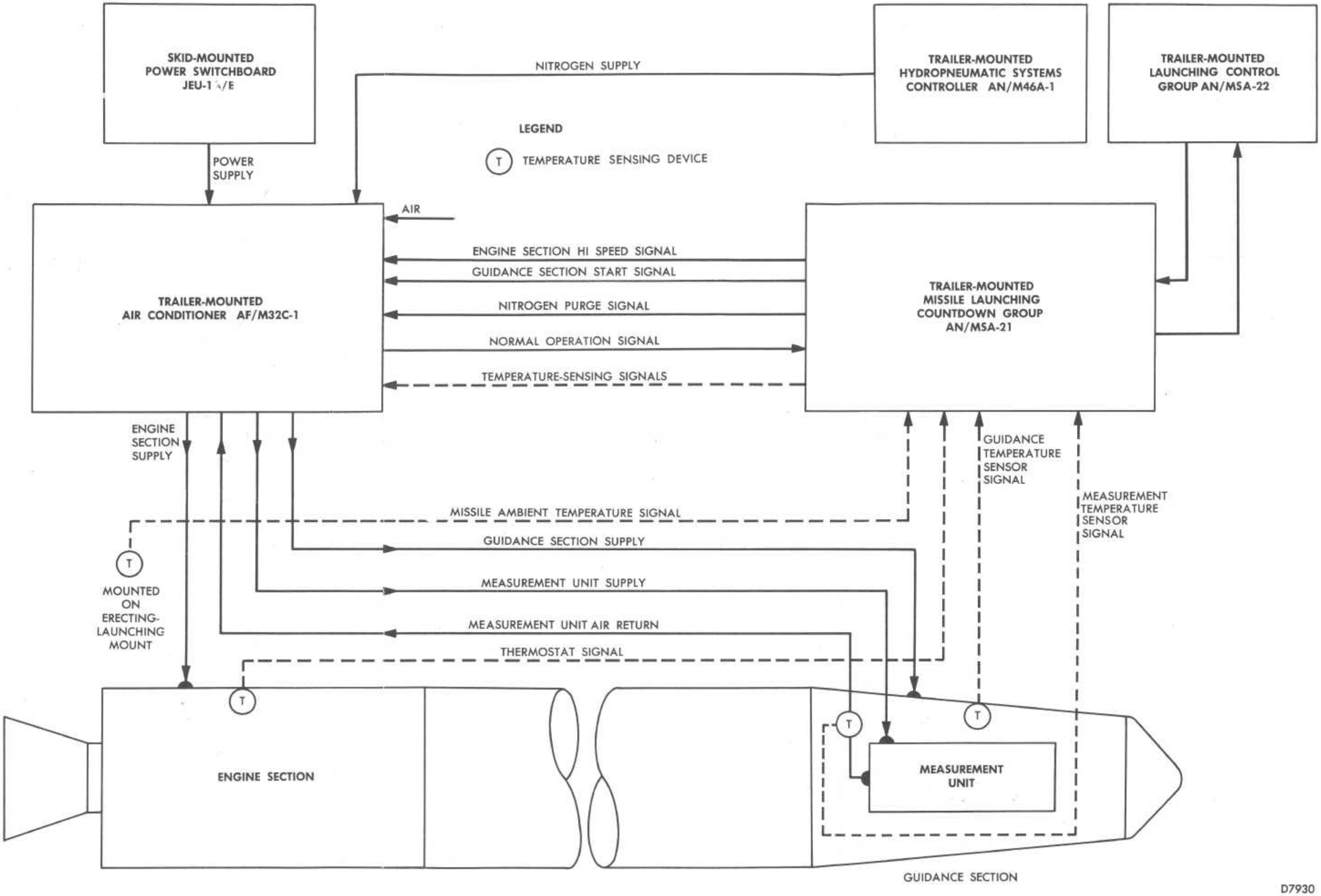


Figure 1-1. Missile Air-Conditioning System—Block Diagram

Figure 1-1. Missile Air-Conditioning System — Block Diagram

1-4 1 October 1960

T.O. 21-SM75-1F-2-5 Section I

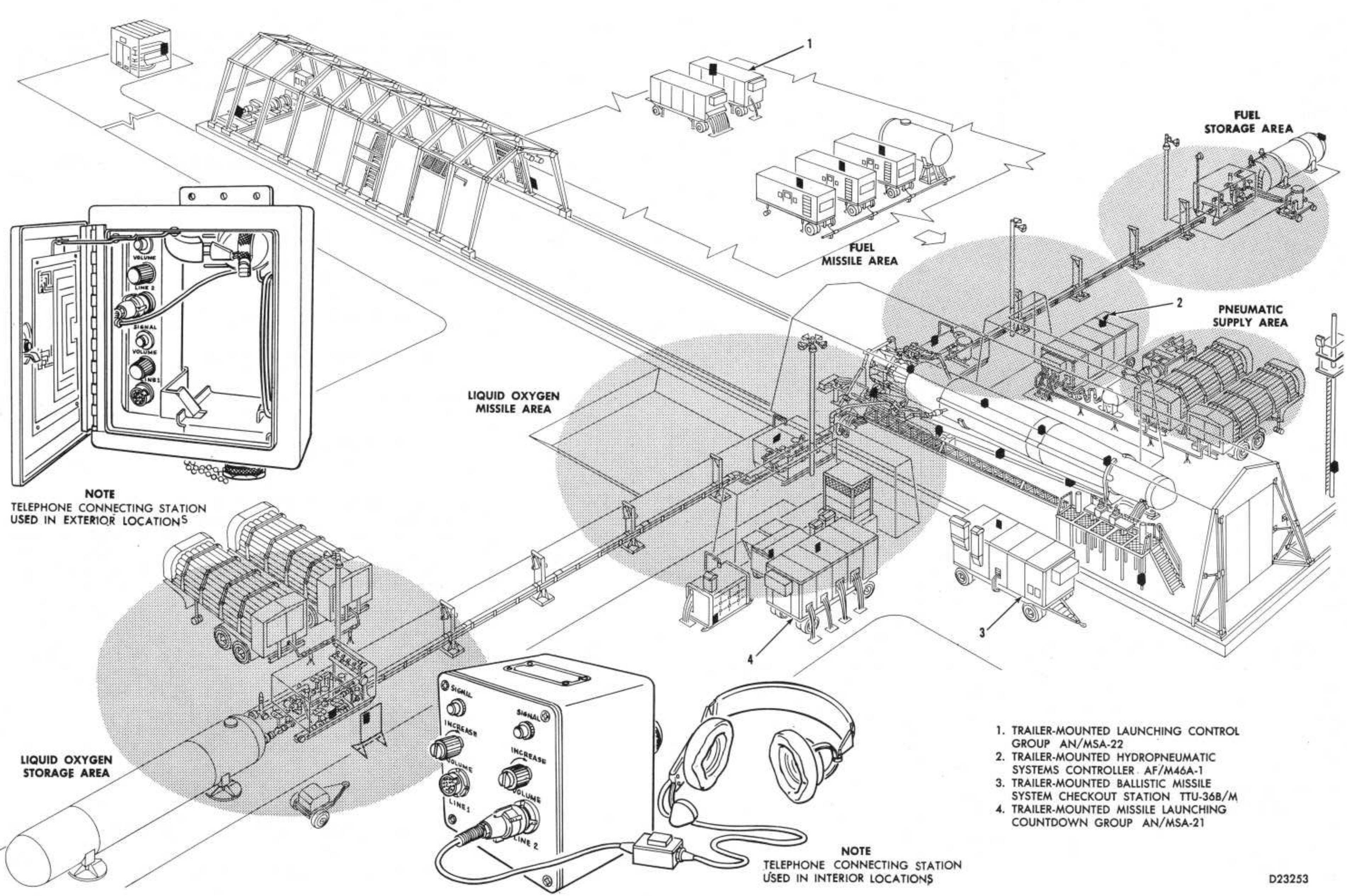


Figure 1-1. Launch Emplacement Maintenance Communications Network

Figure 1-1. Launch Emplacement Maintenance Communications Network

Changed 1 November 1960 1-3

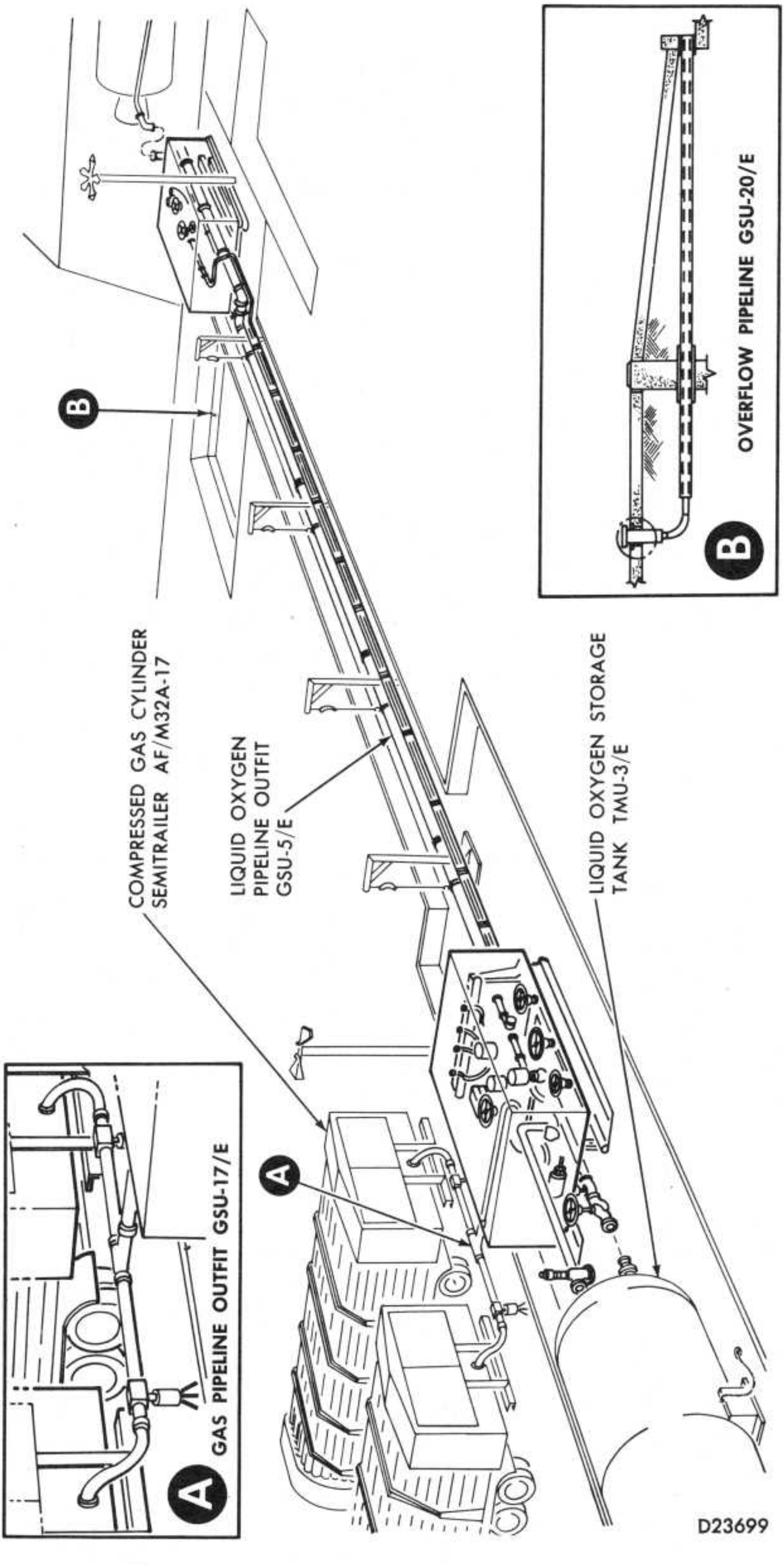


Figure 2-1. Liquid Oxygen Transfer Subsystem

Section II T.O. 21-SM75-1F-2-5 Section II T.O. 21-SM75-1F-2-5

T. O. 21-SM75-1F-2-5 Section II

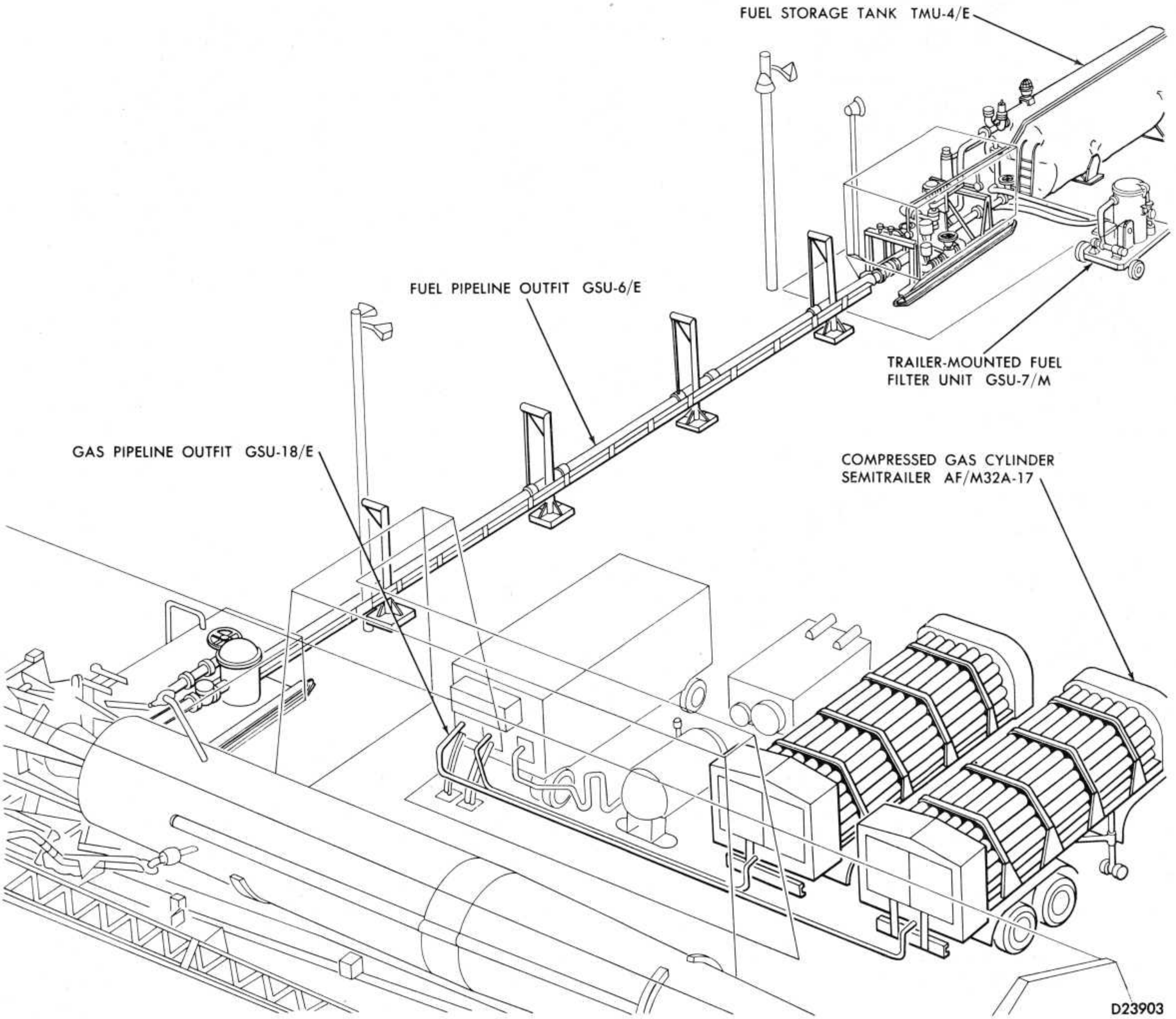
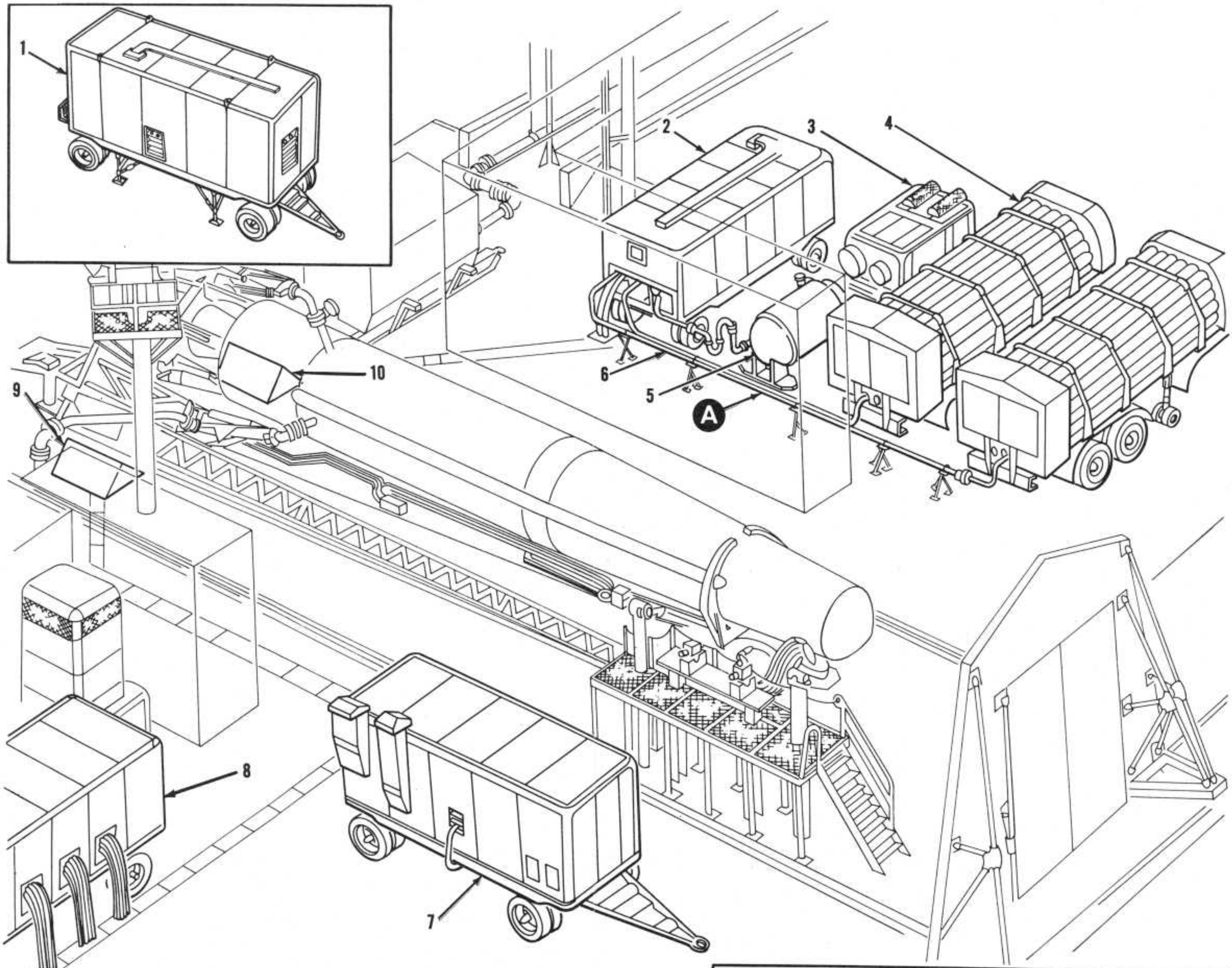


Figure 2-2. Fuel Transfer Subsystem

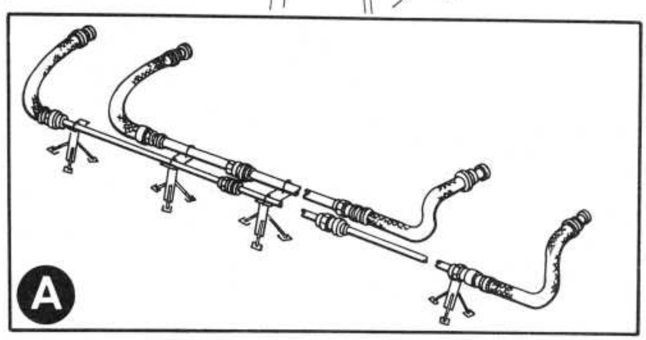
Figure 2-2. Fuel Transfer Subsystem

1 August 1960 2-3

Section II T. O. 21-SM75-1F-2-5



1. TRAILER-MOUNTED LAUNCHING CONTROL GROUP AN/MSA-22
2. TRAILER-MOUNTED HYDROPNEUMATIC SYSTEMS CONTROLLER AF/M46A-1
3. POWER-DRIVEN RECIPROCATING COMPRESSOR A/M32A-26
4. COMPRESSED GAS CYLINDER SEMITRAILER AF/M32A-17
5. HIGH-PRESSURE GAS STORAGE TANK TMU-6/E
6. GAS PIPELINE OUTFIT GSU-18/E
7. TRAILER-MOUNTED BALLISTIC MISSILE SYSTEM CHECKOUT STATION TTU-36B/M
8. TRAILER-MOUNTED MISSILE LAUNCHING COUNTDOWN GROUP AN/MSA-21
9. LIQUID OXYGEN SIDE JUNCTION BOX GSU-8/E
10. FUEL SIDE JUNCTION BOX GSU-9/E



D23902

Figure 2-3. Electrical and Pneumatic Supply Equipment

Figure 2-3. Electrical and Pneumatic Supply Equipment

2-4 1 August 1960

T.O. 21-SM75-1J-2-18-1 Section III

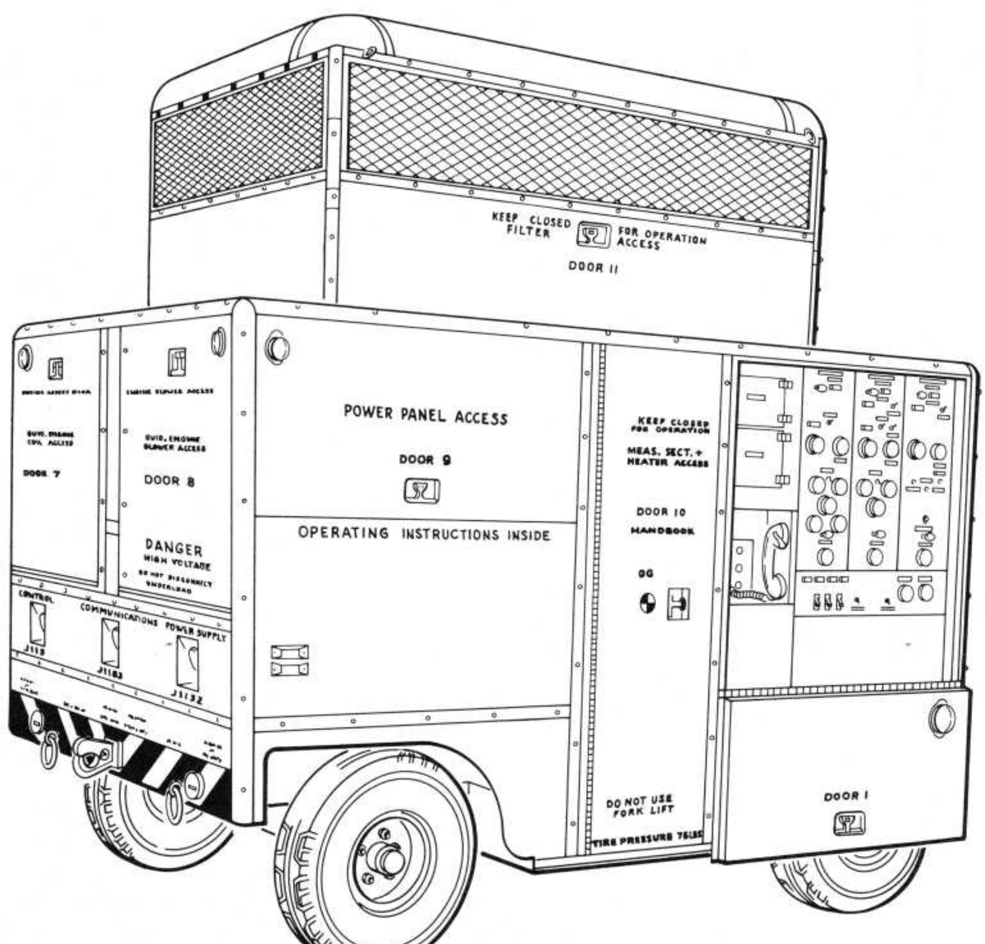


Figure 3-1. Trailer-Mounted Air Conditioner AF/M32C-1 or A/M32C-8

Figure 3-1. Trailer-Mounted Air Conditioner AF/M32C-1 or A/M32C-8

Changed 1 December 1961 3-3

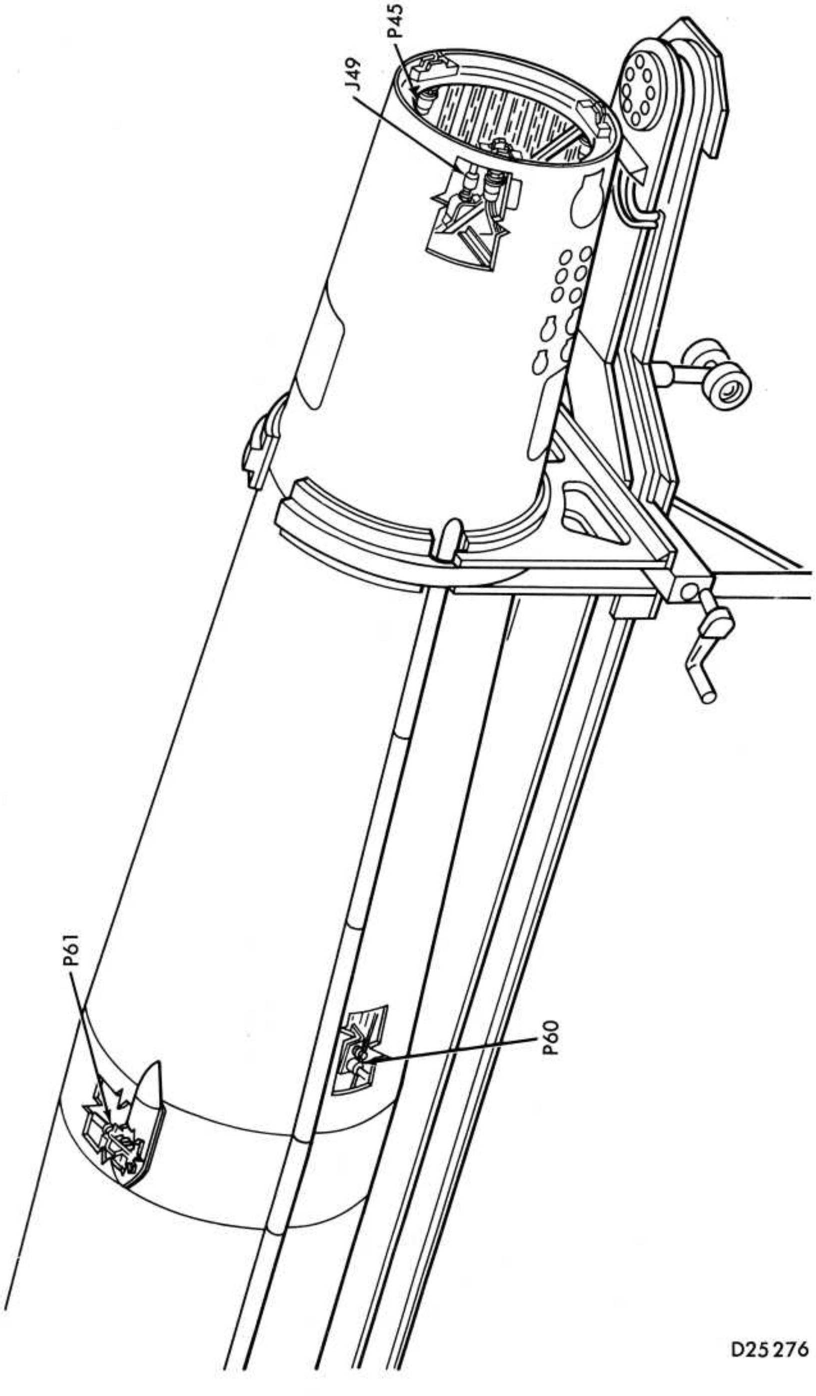


Figure 3-3. Test Points for Multimeter Connections — SM-75 Missile

T.O. 21-SM75-1J-2-18-1 Section III

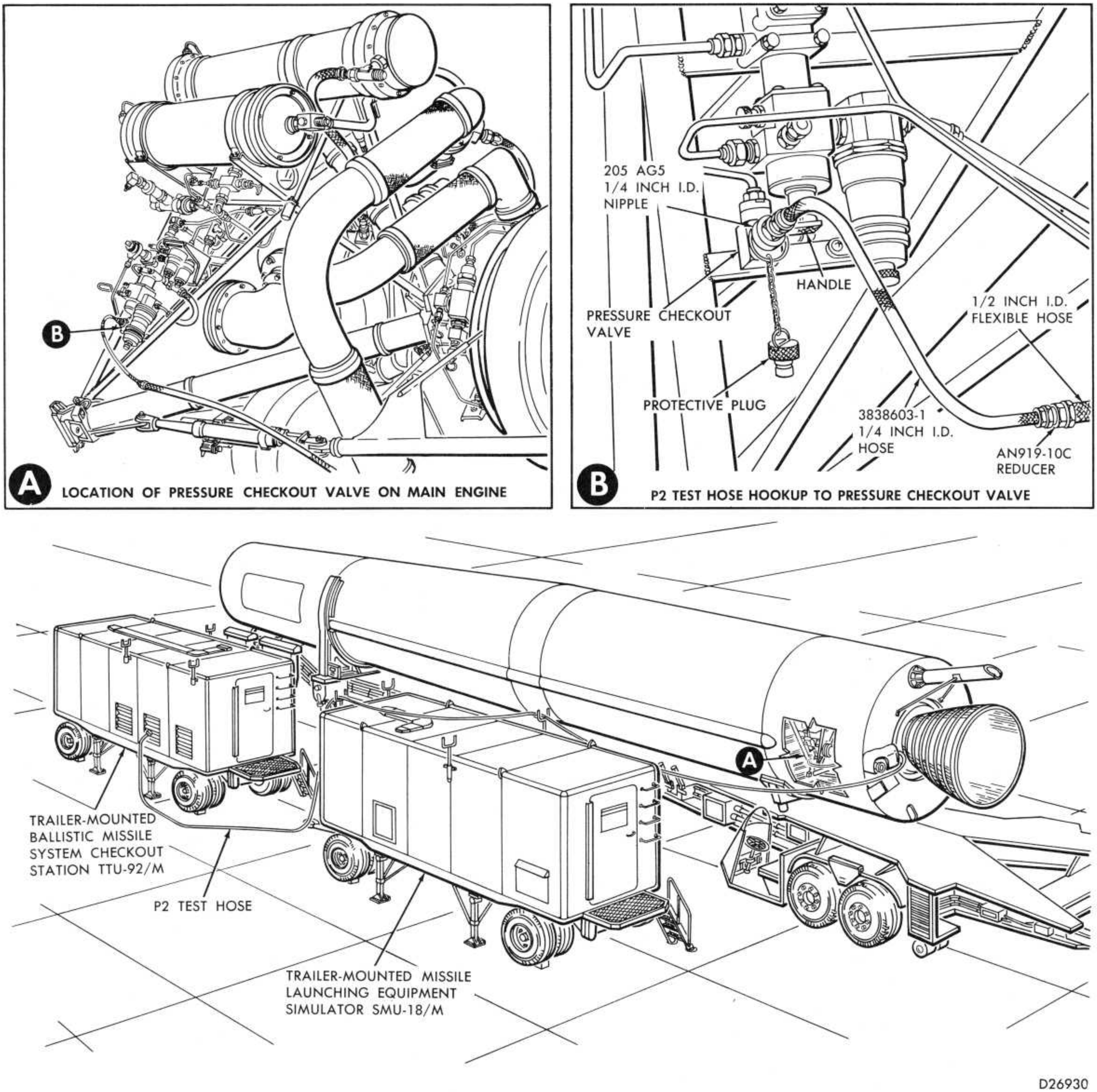


Figure 3-5. P2 Test Hose Installation

Figure 3-5. P2 Test Hose Installation

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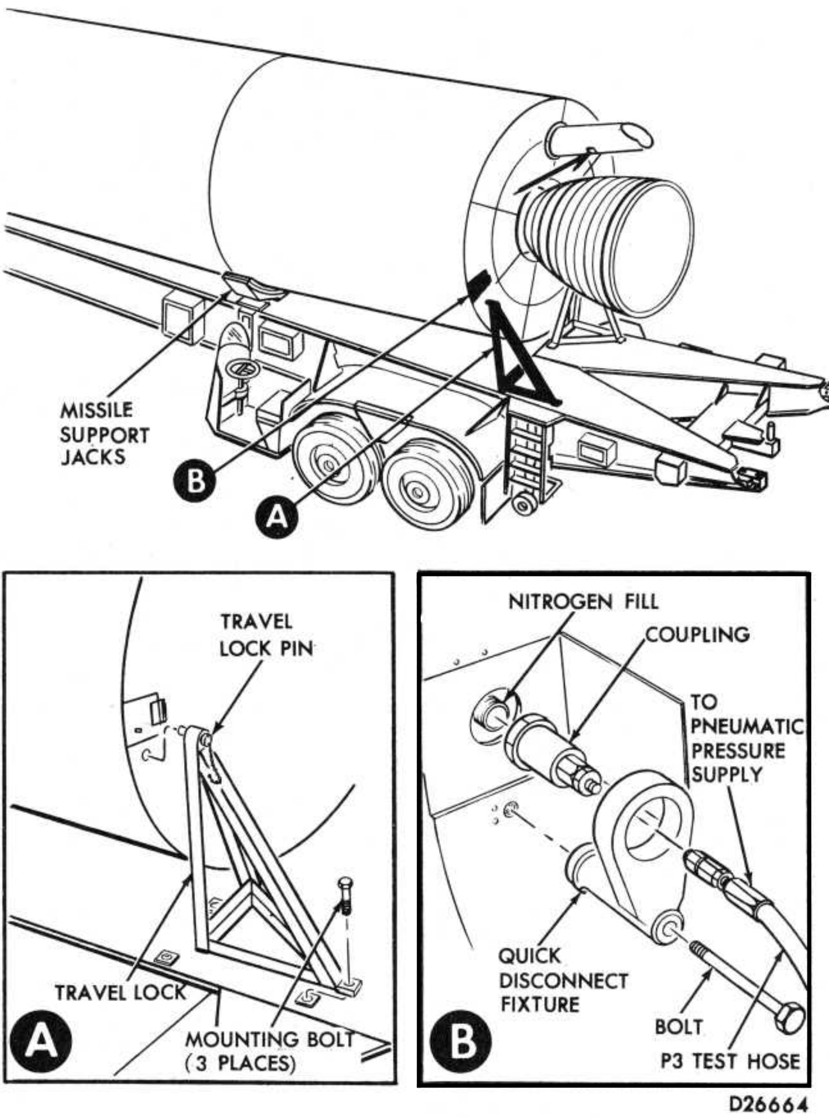


Figure 3-6. Quick-Disconnect Assembly and Pneumatic Pressure Supply Hose Installation

(c) Secure fixture with AN16C-56 bolt in travel lock-pin hole.

(5) Connect ¾-inch hose to quick-disconnect coupling.

(6) Connect opposite end of hose to facility supply.

j. Connect hydraulic pressure and return hoses to missile and missile launching equipment simulator as shown in figure 3-7.

k. Obtain Signal Isolation Test Adapter from MCS and install as shown in figure 3-8.

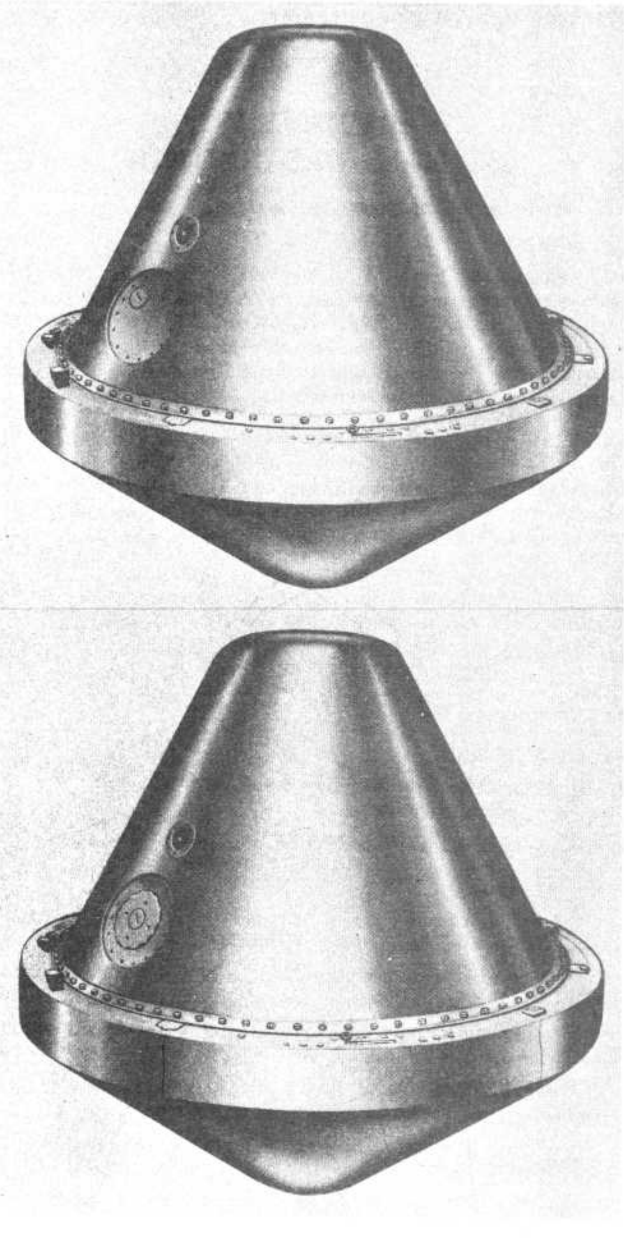


Figure 1-1. Re-entry Vehicle AF/A37E-2(XC-2A)

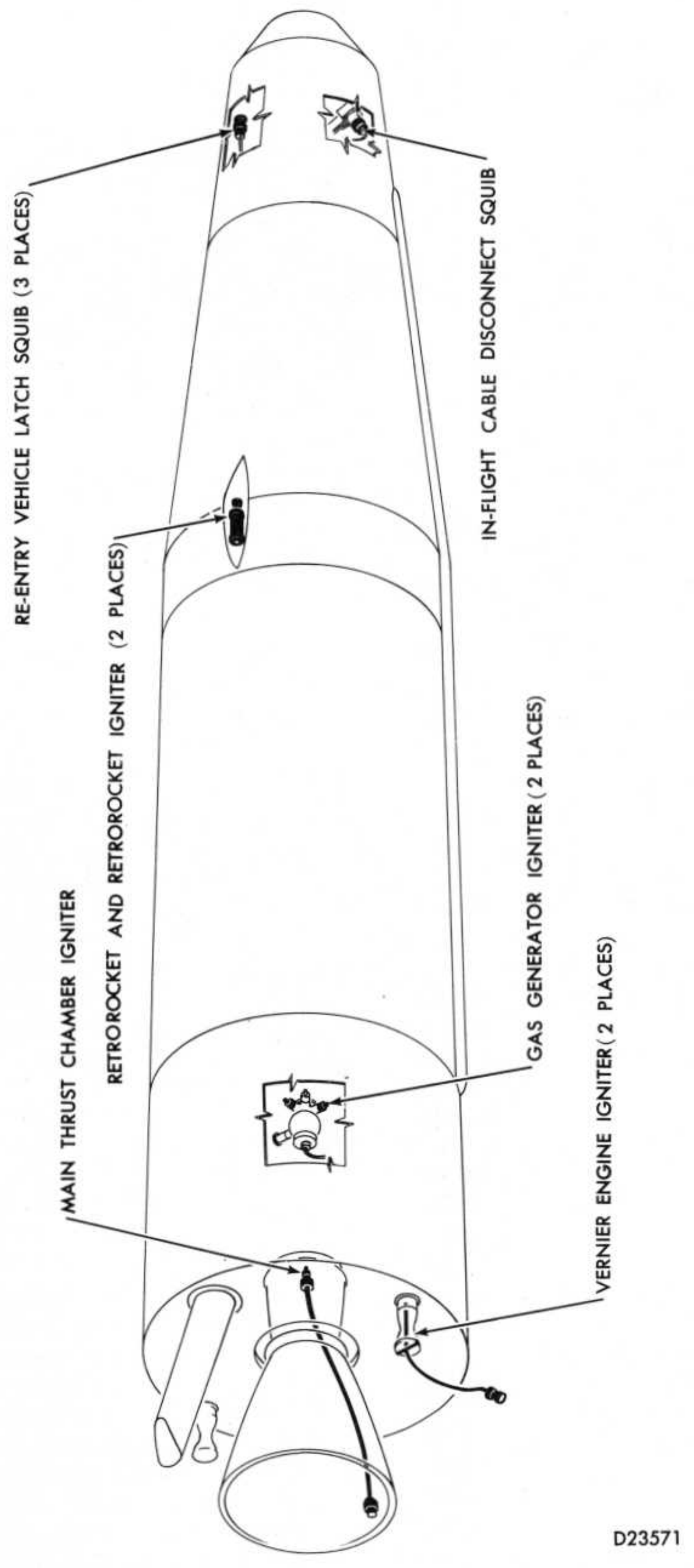


Figure 1-1. Explosive Components — Location

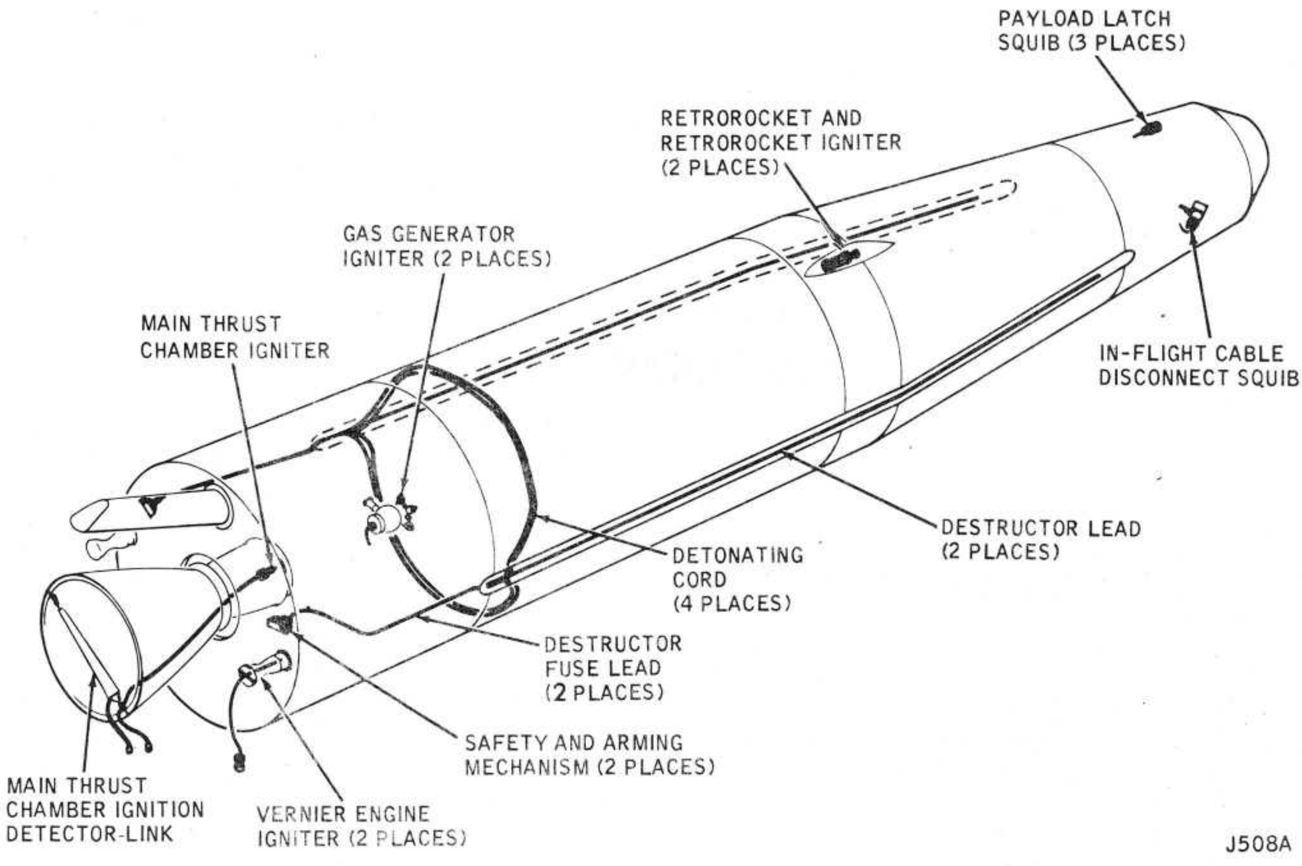


Figure 1-1. Launch Vehicle Explosive Components

Table 1-1. Summary of Explosive Components

Explosive Component	Part Number	Use
Destructor Kit	1A97631-1	Connects safety and arming mechanisms to detonating cords and destructor leads.
Destructor Fuse Lead (2 required)	1A97636-1	
Destructor Lead (2 required)	1A97635-1	Destroys forward and aft sections of launch vehicle.
Detonating Cord (4 required)	1A97634-1	Destroys liquid oxygen tank.
Explosive Kit	1A97681-1	
Gas Generator Igniter (2 required)	650717	Ignites gas generator.